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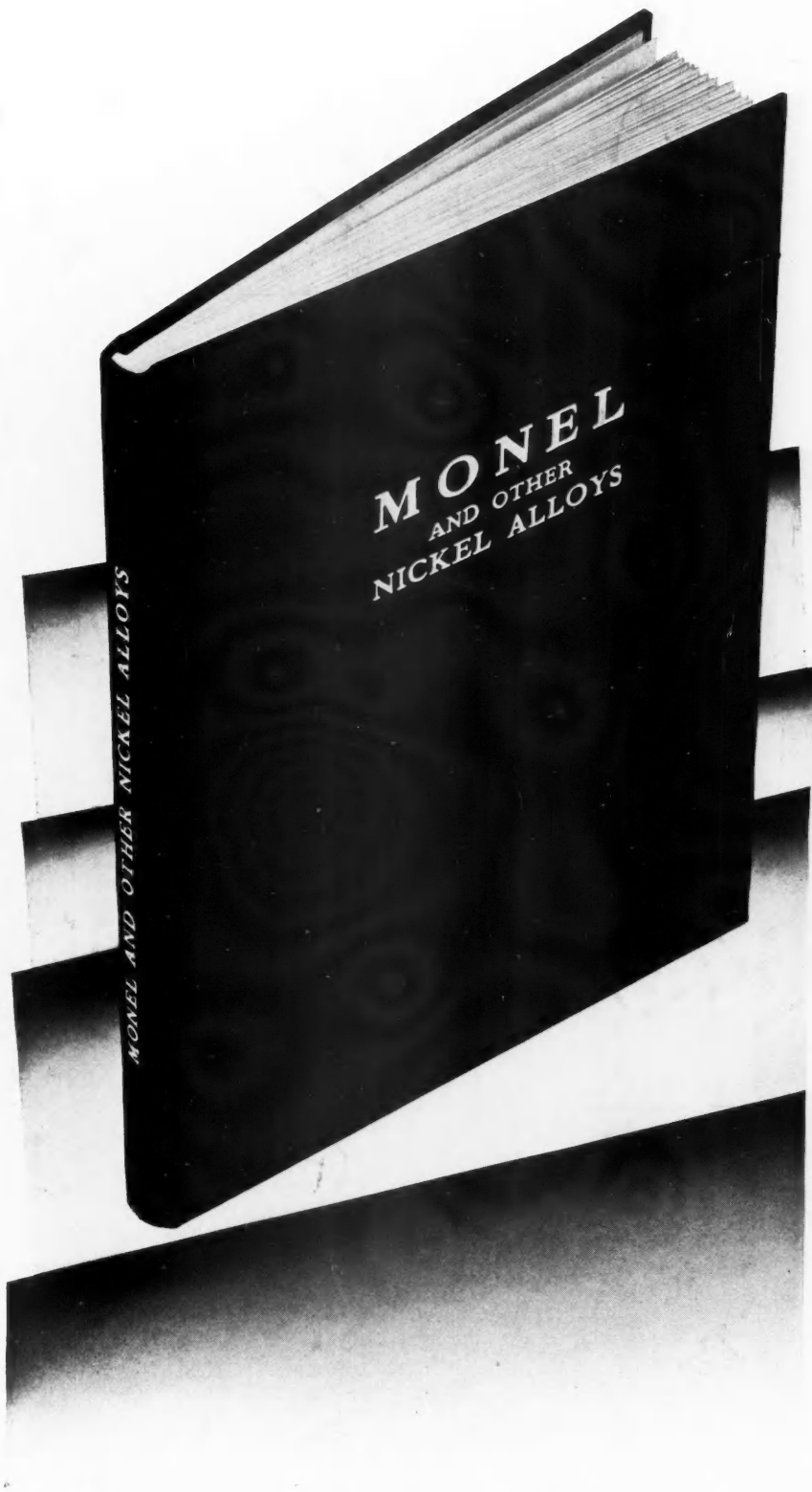

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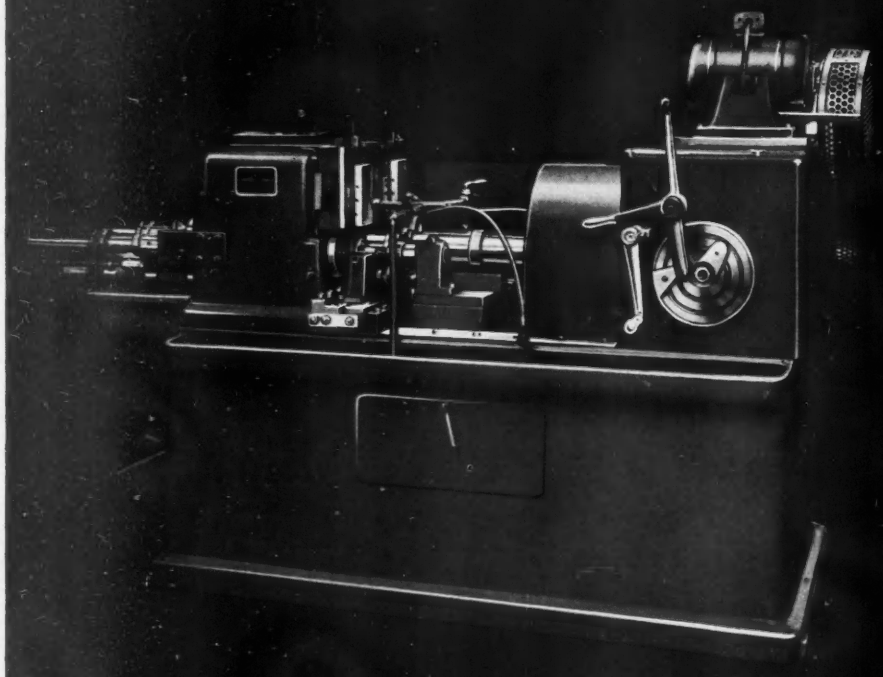

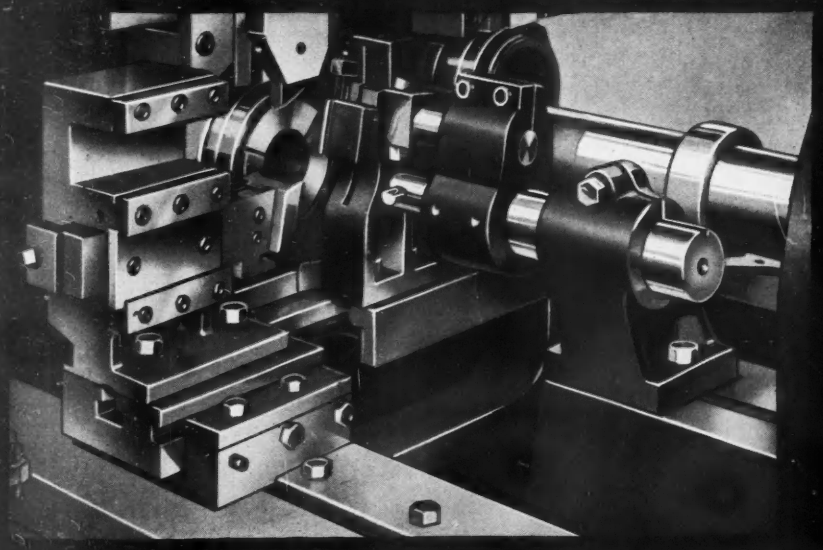

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British Naval Strength

A STATEMENT issued by the Admiralty on Saturday, June 8th, points out that the balance of naval strength in favour of the Allies is now far greater than at the outbreak of war. The pre-war strength of the British Empire navies and the losses suffered up to Saturday, June 8th, are as follows :—At the outbreak of war we had 15 capital ships and 1 has been lost ; 7 aircraft carriers, 1 has been lost ; 62 cruisers, 2 have been lost ; 185 destroyers, 20 have been lost ; 58 submarines, 8 have been lost ; and 108 minesweepers, sloops, patrol vessels, and gunboats, of which 6 have been lost. Since the beginning of the war, in addition to reinforcements of warships of all classes, except battleships, the Navy has been strengthened by more than 50 armed cruisers, of which one has been lost, and more than 1500 minor war vessels and auxiliary craft, of which 58 have been lost. The French Navy is a rapidly growing force, and the Allied Fleets have been reinforced by the active co-operation of Polish, Dutch, and Norwegian naval forces. During the next few months the Royal Navy will receive a further large increase in strength, comprising every category of warship from battleships to motor torpedo boats, and a very large number of auxiliary craft. The acceleration of work in the shipyards is such that the output of new construction is progressively increasing. Nearly 1,000,000 tons of warships are building in British shipyards. The German Navy has suffered the destruction of a high proportion of its effectives. The contrast between German naval weakness and the great and growing strength of the Allied navies has apparently alarmed the German High Command, which has sought to convince neutral opinion, by the groundless claims of naval sinkings, that German air power has achieved a spectacular ascendency over British naval power. Nine months of war experience, the Admiralty states, enables the balance to be struck. Concentrated air power in close proximity to its own aerodromes can inflict losses on the less strongly armoured naval units. It has signally failed, however, to annul the decisive advantages conferred by sea power. Since the Admiralty's statement was issued the loss has been reported of the aircraft carrier "Glorious" and the destroyers "Acasta" and "Ardent."

The Area Supply Boards

IT will be recalled that Area Supply Boards have been established in each of the civil defence regions, except the London and South-Eastern regions, which have been combined to form one area, in order to secure in each area co-ordination of effort and full utilisation of capacity and labour supply for the production of war material. The Boards originally consisted of representatives of the Admiralty, the Air Ministry, the Ministry of Supply, and the Ministry of Labour. To these representatives the President of the Board of Trade, Sir Andrew Duncan, has now appointed the following members, in order that the Government Departments concerned with essential production, including production for export, may be fully represented :—Scotland : Sir Stephen Bilsland, Office of the District Commissioner, Western (Scotland) District Headquarters, 95, Bothwell Street, Glasgow, C.2 ; Northern Ireland : Mr. W. D. Scott, Ministry of Commerce, Chichester Street, Belfast ; North-Western : Sir Thomas Barlow, 2, Portland Street, Manchester, 1 ; Midland : Mr. W. L. Chance, Glass Works, Smethwick, near Birmingham ; London and South-Eastern : Mr. Guy Locock, care of Ministry of Supply, Savoy Hill House, London, W.C.2 ; East and West Riding : Mr. Colin Laycock, care of the Sheffield Chamber of Commerce, Cutlers' Hall, Sheffield ; Welsh : Mr. John Powell, Baltic House, Mount Stuart Square, Cardiff ; North Midland : Mr. A. G. Howitt, Alfred Street Mills, Nottingham ; South-Western : Mr. H. G. Turner, E. S. and A. Robinson, Ltd., Bristol, 1. The appointments for the Northern, Eastern, and Southern Boards are to be announced as soon as possible.

Quicker Decisions Required

AT the annual meeting of the London Chamber of Commerce which was held in London on Thursday, June 6th, Sir Alexander Gibb, G.B.E., the retiring President, proposed a resolution calling for quicker decisions by Government Departments in dealing with business questions. The resolution, which was passed unanimously, recognised that the Government was now engaged in business on a vast scale, and that day-to-day decisions were required. The Chamber urged in the strongest possible manner that the principle of personal responsibility should be substituted for that of conference, committee, departmental and interdepartmental reference, in all those cases where the exigencies of business demand speedy decisions. The Chamber expressed its conviction that all the arguments which in peace time could be advanced for a system of check and counter-check were outweighed in war time by the imperative need for rapid decision. In proposing the resolution, Sir Alexander said that the Chamber did not want to make any reflection on the Civil Service, which included men of outstanding ability and high capacity among its rank and file. The system of check and counter-check, designed over the years to prevent corruption, had, he said, been developed to such a point that nearly every subject passed through several hands, and if of importance not infrequently through several departments. In peace time the results secured might well justify the delay and the expense involved, but in time of war, and especially in war as fought to-day, time was vital. He appreciated that there were subjects in which more than one department was concerned, but he was equally convinced that unless full authority to act was delegated to one department—the others being informed of the decisions taken—the country would not cease to hear at frequent intervals the terrible indictment, "Too late!" Not only should decisions rest with the department primarily concerned, but that department should place upon named individuals the full responsibility for making rapid decisions. The new President of the Chamber is Sir Geoffrey Clarke, who, as an industrialist, expressed the view that the outcome of the war would depend upon industry, and it would be the product of the factories that would conduce largely to its success.

Industrial Safety, Health and Welfare

AN Order in Council was made on Friday, June 7th, transferring the powers of the Home Secretary under the Factory Acts to the Minister of Labour and National Service for the period of the war. In order to assist him in giving effect to these powers and in stimulating and developing to the fullest extent the safety, health, and welfare arrangements inside the factories and the billeting, communal feeding, and welfare arrangements outside the factories, the Minister of Labour and National Service has established a Factory and Welfare Advisory Board, consisting of the Minister as Chairman, the following official representatives from the Ministry :—Sir Thomas W. Phillips (Permanent Secretary), Mr. R. Assheton (Parliamentary Secretary), Mr. F. W. Leggett (Chief Industrial Commissioner), and Mr. G. H. Ince (Under-Secretary), together with Miss E. M. Batten, Mr. J. Hallsworth, Miss A. Loughlin, Air Vice-Marshal Sir David Munro, the Dowager Marchioness of Reading, and Mr. A. P. Young. Mr. G. R. A. Buckland, Assistant Under-Secretary, Home Office, seconded to the Ministry of Labour and National Service, will act as Secretary to the Board. Mr. A. W. Garrett, Chief Inspector of Factories, will attend the meetings of the Board. The first meeting of the Board was held at Montagu House, Whitehall, S.W.1, on Monday, June 10th. The Minister has established in the Ministry of Labour and National Service a Factory and Welfare Department, of which the Factory Department transferred from the Home Office forms a part, for the purpose of carrying out the new duties imposed upon him. This Department will work in close co-operation with the Industrial Health Research Board, Local Authorities, trades unions, and employers' organisations, and voluntary organisations dealing with the various aspects of the safety, health, and welfare of men, women, and young persons engaged in industry. Questions of health and safety at mines and quarries will continue to be dealt with by the Mines Department, including questions of the welfare of mine workers which are dealt with by the Miners' Welfare Commission. Communications for the factory inspectorate should continue to be addressed to their central and local offices as hitherto. Communications on Factory Act matters which would have been addressed to the Under-Secretary of State, Home Office, should now be addressed to the Secretary, Ministry of Labour and National Service (Factory and Welfare Department), Cleland House, Page Street, London, S.W.1. All other communications on welfare matters should be addressed to the Secretary, Ministry of Labour (Factory and Welfare Department), Montagu House, Whitehall, S.W.1.

Amalgamations in the Coal Industry Postponed

ACCORDING to the reports of the Coal Commission for the years 1938 and 1939, which have just been issued as a White Paper, the proposals for widespread reorganisation of the coal industry by the amalgamation of mines into district groups is to be postponed until after the war. The reports of the Commission recall the proposals outlined by it in a memorandum to the colliery proprietors which was issued a year ago, and state that it was proposed to review the response made towards the end of 1939 and to report to the Board of Trade on any areas in which it might think that conditions for the exercise of compulsion had arisen. On the outbreak of war, however, the Commission decided that it was impossible to expect colliery owners to address themselves to the far-reaching questions at a time when they were confronted with so many difficulties in the carrying on of their ordinary business. The Commission therefore thought it necessary to regard Part II of the Coal Act, giving it powers to further the reorganisation of the industry by amalgamations, as being in suspense for the present, though its help is always at the disposal of colliery owners who wish to make their own amalgamations. The Commission hopes that at the end of the war its task may be resumed, as the need for it is considered likely then to be even more urgent than when the Act was passed. The report states that the total number of applications for registration on the coal register was 30,428. The proposals which were put forward last June provided for the merging of 819 colliery undertakings in twenty-one districts into forty-two groups.

Employment Returns

IT was officially announced by the Ministry of Labour and National Service on Monday evening, June 10th, that between April 15th and May 20th there was a reduction of 91,873 in the number of unemployed persons on the registers of employment exchanges in Great Britain. The total of 880,822 for May 20th, 1940, was 611,460 less than the figure for May 15th, 1939. The reduction in unemployment applied to all areas and to most of the principal industries. It is to be noted that in addition to unemployed absorbed into the industries engaged on war work, there is also a steady flow by transfer into those industries from less essential industries which is not reflected by the reduction in the total of unemployment. The total reduction in unemployment is by no means an adequate measure of the changes in employment in the industries engaged upon war work. An analysis of the numbers of unemployed on the registers on May 20th shows that the total of 880,822 is made up of 468,990 men totally unemployed, 56,266 temporarily stopped, of which 45,456 persons are normally in casual employment. Similar figures for boys are 15,843, 1317, and 125 ; for women employees, the figures are 217,852, 43,012, and 1736 ; and for girls 28,108, 2135, and 2. There was a marked decrease of unemployment in the building and distributive trades, hotel services, public works contracting, agriculture and horticulture, local government service, coal mining, motor vehicle, cycles and aircraft manufacture, the road transport, and the engineering industries. Unemployment increased in the month under review in the dock and harbour services, the cotton, paper, textile, and the printing and dyeing industries.

Restriction on Engagement Order

THE Minister of Labour and National Service, Mr. Ernest Bevin, announces that on Monday, June 10th, there came into force the Restriction on Engagement Order, which was made by the Minister of Labour and National Service on Wednesday, June 5th. The Order has, broadly speaking, the following effect :—As from June 10th no employer in the building industry, the civil engineering contracting industry or the general engineering industry may engage a worker or seek to engage one, except by notifying particulars of the vacancy to the local office of the Ministry. Similarly, all workers in such industries will in future obtain work in their trade only by applying at the local office of the Ministry. In both cases trade union arrangements approved by the Minister may be substituted for the local office of the Ministry. It follows, of course, that unauthorised advertisements or "poaching" of workers in these industries will be illegal. It will not be illegal for employers to re-engage workers who were last employed by them at some date not more than fourteen days before the date of the re-engagement. Under another part of the Order it is provided in broad terms that a man who is normally a coal mine worker or an agricultural worker may not be engaged for any other industry unless sent to work in it by the employment exchange. If he has left his normal occupation and taken another job, he will, after losing his new job, not be able to return to it if he has been out of it for more than a fortnight, but will generally be offered work in his previous form of employment. The industries are defined in the Order and the definition of general engineering is widely drawn. All workers in the industries are concerned, except managers, salesmen, clerks, and domestic workers. All who are concerned are advised to make themselves acquainted with the Order, and in any case of doubt to consult the employment exchange service. There are severe penalties for infringements of the Order which is necessary in order to secure the best use of the country's labour supply for war purposes.

British Canning Plant

No. II

(*Continued from page 521, June 7th*)

UNTIL recently sterilising was invariably carried out in a so-called "retort," really an autoclave or pressure vessel, in which the cans were placed in a metal basket and lowered into a steam-heated cylindrical chamber, then heated for an hour or more. This procedure not only wastes a great deal of time in packing the cans ready for the retort, but the long period of heating necessary to get an even temperature throughout the mass of cans in the basket inevitably led to the destruction of some of the food value in the produce. It is not surprising, therefore, that canning plant manufacturers have sought alternative means of enabling the sterilising process to be speeded up so that it may keep pace with the other units of plant. The saving of time effected by a modern type of steriliser, compared with the older retort method, is illustrated by Fig. 6, in which the dotted line represents the retort process. This shows that commencing from an initial temperature of 160 deg. Fah. a modern plant will both raise the produce to a higher temperature and also

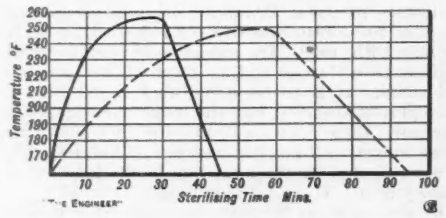


FIG. 6—STERILISING TIMES, OLD AND NEW

cool it again to starting point before the retort system has reached its maximum temperature. A typical representative of this new type of plant is seen in the left background of Fig. 7. In this plant the sealed cans enter at a higher temperature than is the case with a retort steriliser, for in this latter method they have time to cool before they can be put into the retort, which means a reduction in processing time and an economy in steam. The steriliser, which incorporates a cooler, operates automatically and continuously, and may be synchronised with the seaming machines and other plant units. It is of the non-agitating type, and the cans remain practically in the same position throughout their passage from seamer through steriliser and cooler and finally to the stores. On entering the steriliser the cans are led on to the top of a spiral mechanism and caused to gravitate through a circuitous route to the bottom of the spiral, whence they enter the cooler section, to be cooled under pressure with the aid of compressed air and cooling water. At the base of the steriliser and directly under the spiral mechanism are two perforated steam lines, which project low-pressure steam, generally under 40 lb. per square inch pressure, upwards through the loaded spiral. Apart from the shorter processing time for a given number of cans a further saving of steam is effected by the machine being insulated with non-conducting material covered with planished steel sheeting; thus radiation losses are reduced to a minimum. Moreover, as the machine is a continuous type its used steam can be economically utilised in the exhausting machine. On the contrary, the older type of retort steriliser suffered heavily from heat losses due to radiation; and because it had to serve also as a cooler, in which cold water sprays played on the sterilised cans, it could not be practicably insulated.

In Figs. 8 and 9 a close-up view is given of the can inlet valve and can discharge valve respectively, the former showing cans entering the steam-heated chamber of the steriliser and the latter the cans emerging from the cooler section of the machine. These rotary can valves are simple in construction, steam-tight, and fitted with automatically adjustable spring loaded wearing plates. The valves themselves are capable of dealing with the various sizes of cans without any alteration, and a change over from one size of can to another merely involves a change of worm and guide on each valve, small doors being provided near both inlet and discharge valves to facilitate the work of changing over, which normally requires only a few minutes. It is necessary that the worm and the valve mechanism feeding the cans to the steriliser should work very accurately. To ensure this the makers of the plant fit up in their works a special equipment, in which exact working conditions in the cannery are simulated, for testing the valve synchronising mechanism, and every worm prior to fitting to a steriliser is given a week's test while actually handling cans. The whole of the internal mechanism of the cooker side of the machine is embodied in a framework carriage, supported on wheels, and can be withdrawn from the outer casing complete in a few moments, with its full complement of cans. By means of both speed and temperature controls on the machine the operator is able to make such variations in sterilising time and steam pressure as may be necessary for different classes of produce. The output of such a machine naturally varies considerably with size of can; for example, with a small size can the output is about 100 per minute, and the steam consumption about 510 lb. per hour. With a larger can, however, if the 100 cans per minute must be maintained, the steam consumption becomes about 1200 lb. per hour. These figures are conditional on the temperature in the centre of the can being 180 deg. Fah. on entering the machine, and that the temperature is maintained at 260 deg. Fah., the steam supply to the steriliser being free from excessive moisture. Cooling water consumption for small cans, with an output of 100 cans per minute is between 20 and 30 gallons per minute; but for the same output of the largest cans about 65 gallons of water are used per minute. This assumes that the temperature of the cans entering the cooler from the steriliser section is not over 260 deg. Fah., that they are cooled to 95 deg. Fah., that the cooling water does not exceed the tempera-

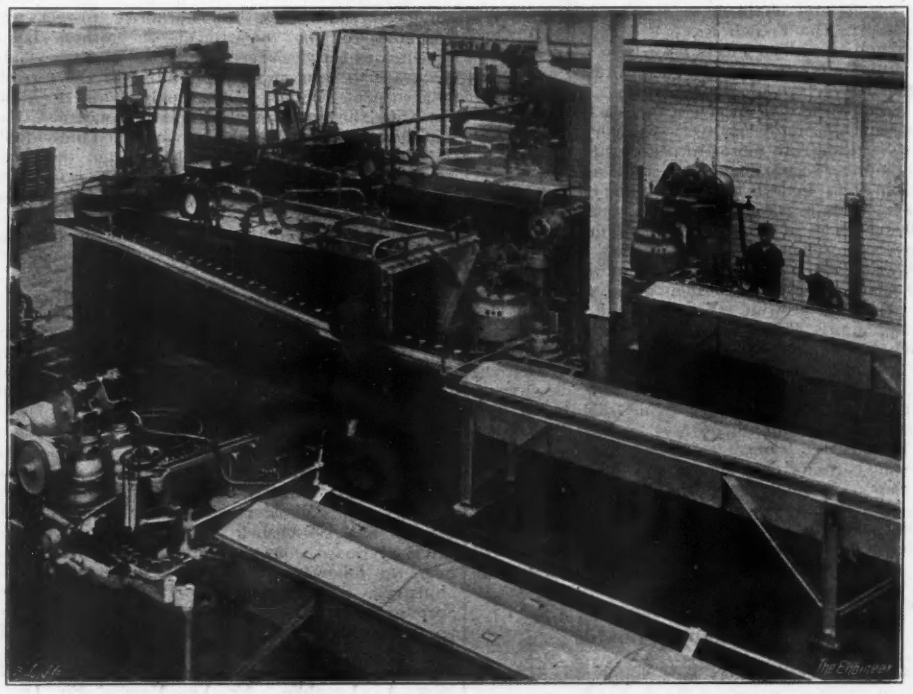


FIG. 7—MODERN TYPE OF STERILISING PLANT

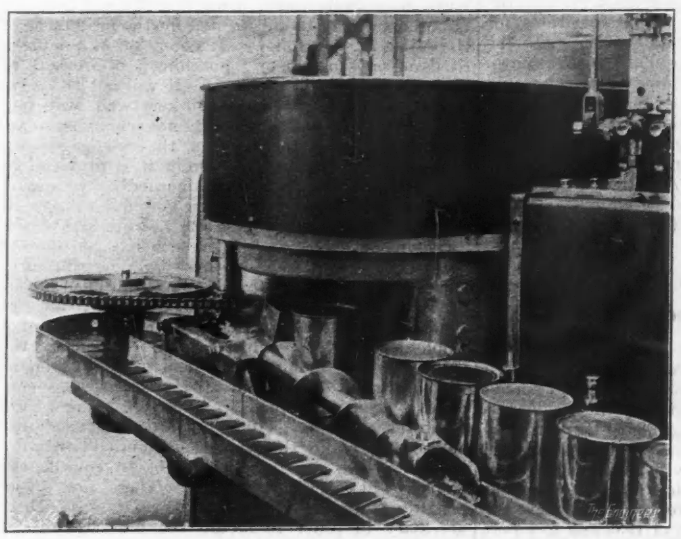


FIG. 8—CAN INLET VALVE

FIG. 9—CAN DISCHARGE VALVE

ture of 55 deg. Fah., and is not exhausted from the cooler at a temperature lower than 110 deg. Fah. These represent the ideal conditions for economical cooling and low water consumption. Water pressure to the cooler should be about 12 to 14 lb. per square inch, and it should be free from solids to prevent clogging of the jets. An outline of this machine, together with other units in the canning line, as arranged for the canning of meat products, is given in Fig. 10.

A sterilising plant of the agitating type is seen in Fig. 11. The steriliser itself is the centre machine of the three, and the feed elevator on the left of this machine conveys the cans into the inlet valve near the top of the vessel. This inlet valve is fitted with safety clutch mechanism which, in case of emergency, automatically throws the valve out of action without interference with the cans already in the steriliser. A rotating element within the steriliser takes up the cans from the inlet valve; the cans passing along this rotary mechanism at a predetermined rate emerge through the discharge valve seen on the right of the machine. The discharge valve is fitted with a sliding clutch and a cover directly opposite the can pockets, and is instantly disconnected from the rotating element if a stoppage is caused by a defective can. The steriliser is isolated from the atmosphere by a 2in. covering of insulating medium held in position by planished steel sheeting and polished steel bars, so considerably reducing loss of heat by radiation. For such produce as milk or cream, which must be heated gradually to maintain its quality and colour, a preheater or "bringing up" unit is employed. This unit is the machine on the left in Fig. 11 and its construction is similar to that of the steriliser. In the preheater the cold cans of milk or cream are heated slowly up to the temperature of the succeeding machine, the steriliser, to which they proceed automatically. Ball and roller journal bearings in the rotating elements are mounted externally and are isolated from the main body by means of packed stuffing boxes, so that the internal mechanism requires neither adjustment nor lubrication. The bodies of the machines are made of heavy steel plates, electrically welded, with the can tracks riveted to the interior. Both feed and discharge valves are automatically lubricated through a force-feed oiler mounted in a convenient position in front of the machine, and all other bearings are arranged for grease gun lubrication. The feed elevators for raising the cans into the inlet valve are of steel plate construction, being fitted with Renolds roller chain and sprockets and so synchronised with the rotating elements as to allow of a continuous flow of cans to the elements. These elevators are held in position by means of a hand-wheel-operated fast-threaded screw and may be manipulated to give free access to the valve pockets for the removal of damaged cans, &c. In the cooler, the unit on the right in Fig. 11, the cans are subjected to cold water under pressure for a period sufficient to reduce the internal pressure in the can to a safe limit before discharge into the atmosphere. Each of the three units has suitably placed manholes to give access to the interior for periodical examination or cleaning without dismantling. Fig. 12 is a close-up view showing the variable speed gears by

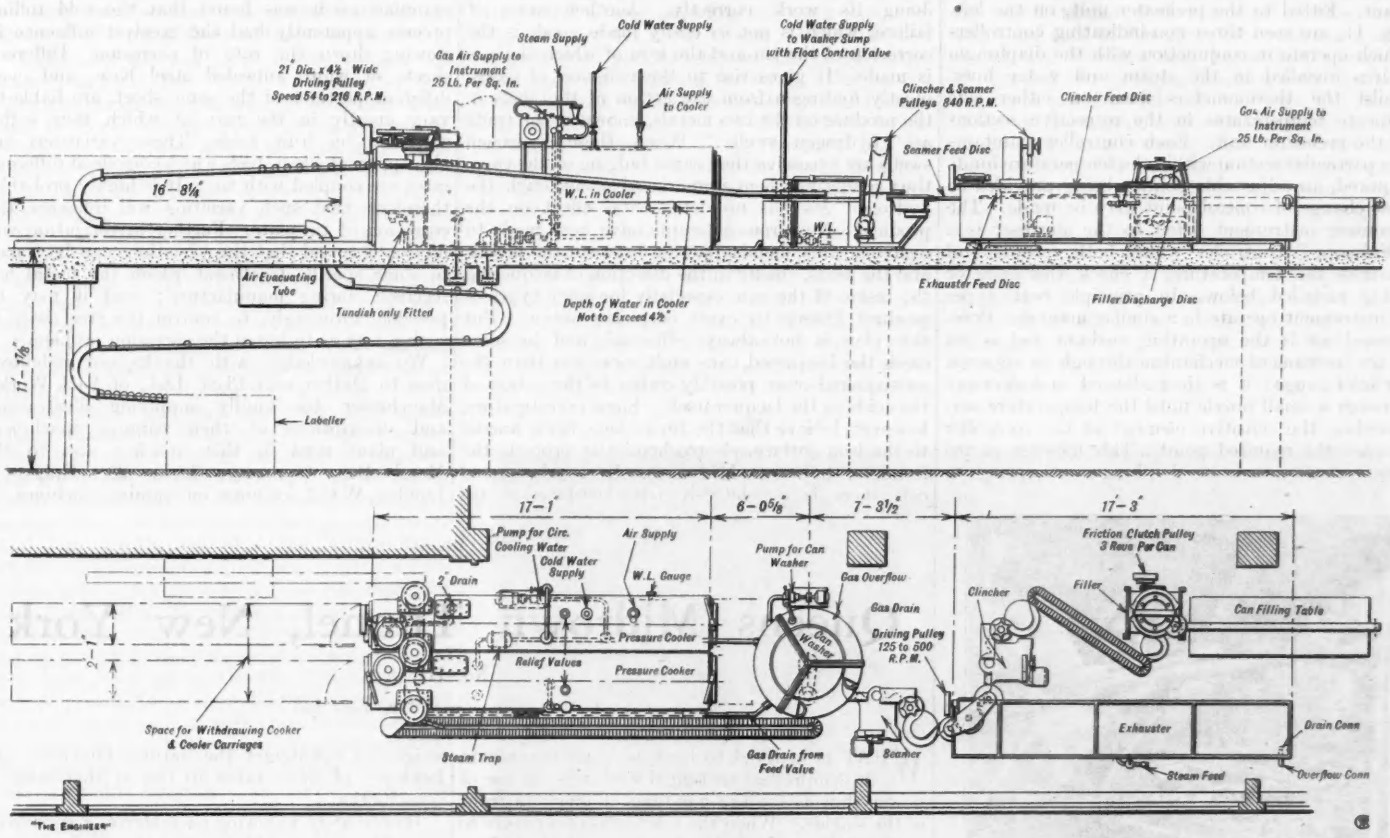


FIG 10—PLANT FOR CANNING MEAT PRODUCTS

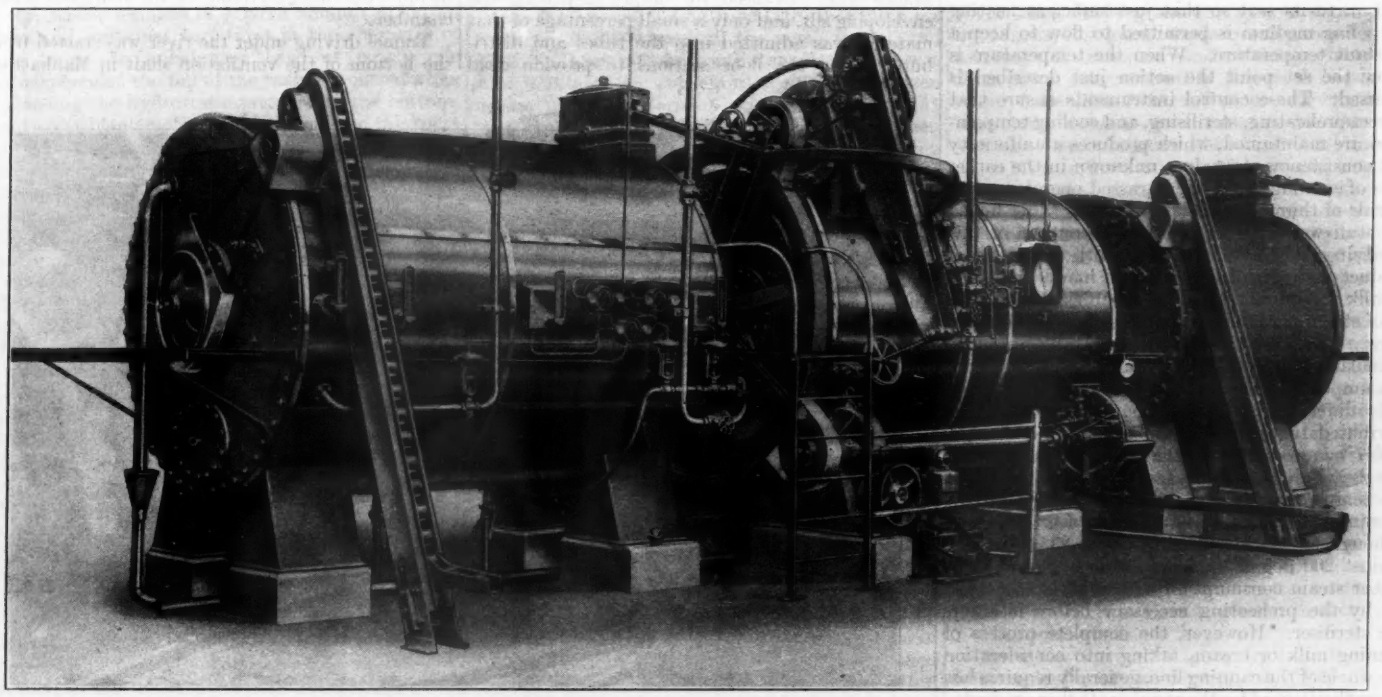


FIG. 11—STERILISING PLANT OF THE AGITATING TYPE

means of which processing time, or speed of the unit, is altered by turning the handwheel which operates the time indicator. A heavy, oil-immersed worm reduction gear is fitted to the auxiliary shaft, and all gearing and elevator chain drives are protected by cast aluminium covers. The machine has automatic lubrication for feed and discharge valves, a sight-feed mechanical force-feed lubricator being operated from the inlet valve shaft.

The temperature control instruments used on the sterilising plant are by Short and Mason and provide the mechanical "nerve centre" of the plant. Fitted to the preheater unit, on the left, Fig. 11, are seen three non-indicating controllers which operate in conjunction with the diaphragm valves installed in the steam and water lines, whilst the thermometers fixed on either side indicate temperatures in the respective sections of the preheater unit. Each controller maintains one particular section within the temperature limits required, an adjustable pointer being provided so that change of control point may be made. The recording instrument fitted to the steriliser is a "Fulscope" controller which both records and controls the temperature, a check thermometer being installed below. In principle both types of instrument operate in a similar manner. Compressed air is the operating medium and is led to the instrument mechanism through an adjacent air inlet gauge; it is then allowed to leak away through a small nozzle until the temperature surrounding the sensitive element of the controller reaches the required point. This increase in the temperature causes a diaphragm or spring to

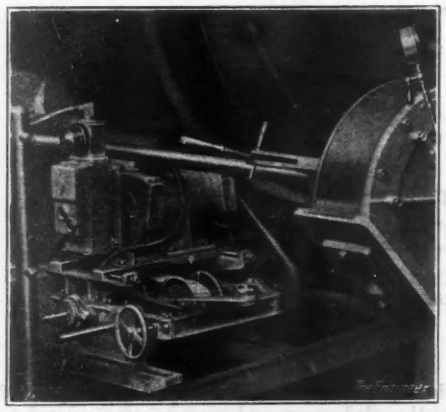


FIG. 12—VARIABLE SPEED GEAR

expand automatically and thus close the air leak at a predetermined temperature. Such action diverts pressure from the instrument and through the air line to the diaphragm valve, where it fills an air-tight chamber causing a rubber diaphragm to inflate. This, in turn, forces a valve down on its seat and correspondingly prevents flow of the heating or cooling medium. The action is so arranged that "throttling" control is maintained, that is, the valve disc is positioned in relation to its seat so that just sufficient heating or cooling medium is permitted to flow to keep a constant temperature. When the temperature is below the set point the action just described is reversed. These control instruments ensure that correct preheating, sterilising, and cooling temperatures are maintained, which produces a uniformity and consistency of product unknown in the earlier days of canning, when the harassed operator relied on rule-of-thumb methods and the manager hoped the stuff would be all right. The output of this sterilising plant naturally varies with the nature of product and size of can. It can handle 150 cans of milk per minute, a 16 ounce can size using 1910 lb. of steam per hour, against 840 lb. of steam for a 5 oz. can. With meat or vegetable produce a similar output can be maintained and the steam consumption is generally less than for milk. This difference in steam consumption may be attributed to the fact that both meat and vegetables come direct to the steriliser hot, about 180 deg. Fah., from the seaming machines; but the temperature of the milk when sealed on the seaming machines is only about 65 deg. Fah., and although milk is sterilised at about 235 deg. Fah. against 260 deg. Fah. for meat or vegetables the higher steam consumption with milk is accounted for by the preheating necessary before it enters the steriliser. However, the complete process of canning milk or cream, taking into consideration the whole of the canning line, generally requires less steam than is used for the canning of other products.

In most food industries some proportion of the manufactured product must be classed as spoilage, but in the canning industry—owing to the vast amount of research work that has been devoted to the subject, in the mechanical and chemical spheres—the proportion of waste in the canned product is very small, probably a small fraction of 1 per cent. The chief causes of failure may be imperfect sterilisation or leakage of air into the can, which result in the formation of moulds and bacteria in the can. The remedy is to see that an efficient type of steriliser is in use, that the operator knows how to use it, and that the seaming machine is doing its work correctly. Another cause of failure, which is not so easily made good, is the corrosion of the tin and the iron of which the can is made. It gives rise to the emission of gases, mostly hydrogen from the action of the acids in the produce on the two metals, known in the trade as "hydrogen swells." When these hydrogen swells are excessive they cause bulging of the cans, thus rendering them unmarketable, although the hydrogen gas has no detrimental effect on the produce. Numerous attempts have been made to overcome this chemical action between the metals and the acids, chiefly in the direction of lacquering the inside of the can, especially for some types of produce known to exert corrosive action. But this plan is not always effectual, and in some cases the lacquered cans emit more gas than the unlacquered ones, possibly owing to the action of the acids on the lacquer itself. Some investigators, however, believe that the tin surface, being anodic to the iron surface, electrochemically protects the iron from the action of the acids. In an unlacquered can there is a relatively large surface of tin available to protect any particular bare spot of iron which has become exposed through the acids dissolving away the tin, but in a lacquered can the area of tin available for this purpose is much less. The tin coating itself is not attacked to a great extent in the absence of oxygen, so that many cases of corrosion can be attributed to air left in the can, either through inefficient exhausting or faulty seaming. Morris and Bryan in recent research work have investigated the corrosive effect of fruit acids on mild steel and tin not in couple, and in testing mild steel at different stages of its manufacture it was found that the cold rolling process apparently had the greatest influence in slowing down the rate of corrosion. Different sheets of white annealed steel base, and even different portions of the same sheet, are liable to vary greatly in the rate at which they suffer corrosion by fruit acids. These variations are also apparent when steels which corrode at different rates are coupled with tin. It is highly probable, therefore, that such variation will influence the corrosion of tin-plate. Further investigation will no doubt reveal that the variations can be traced to some specific treatment which the metal has received during manufacture; and it may be possible, ultimately, to control the steel base in such a way as to lessen the corrosion problem.

We acknowledge, with thanks, our indebtedness to Mather and Platt, Ltd., of Park Works, Manchester, for kindly supplying illustrations and descriptions of their canning machinery and plant used in this article; and to the Metal Box Company, Ltd., 28, Kingsway, London, W.C.2, for notes on seaming machines.

Queens Midtown Tunnel, New York

No. III

(*Continued from page 512, June 7th*)

WHAT is believed to have been an innovation in compressed-air tunnel work was the use of power shovels for the handling of muck in front of the shields. When the muck was of a nature to permit it, it was loaded into cars at each shield by a Conway mucker moved back and forth on a 36in. gauge track, and the machine shovelled the muck on to a conveyor belt which carried the spoil rearward and loaded it into cars conveniently placed for that purpose. After the muck in front of the shield was cleared away, the mucking machine was withdrawn and preparations made for the next shove with the peripheral jacks, at the rear, pushing against the last erected ring of lining. Nearly every ton of material penetrated in driving the four shields of the Queens Midtown tunnel had to be moved rearward into the advancing tunnel and passed thence up to the ground surface for ultimate disposal. In the case of the Lincoln tunnel under the Hudson river, for example, the shields were advanced by simply displacing the enveloping silt, and only a small percentage of that material was admitted into the tubes and distributed along the floor sections to provide dead weight to counteract the natural buoyancy and tendency of those tubes to rise at that stage of construction.

Immediately following each shove, a succeeding ring of lining was added within the enveloping rear end of the shield, and that ring increased the length of the cylindrical tunnel wall by 32in. Each ring of cast iron lining is composed of 14 segments and a key; and an assembled ring weighs about 22·7 tons. High tensile steel bolts were used in assembling the segments of a ring and in securing each ring to its adjoining rings. Adjustments in line and gradient and conformity to curvature were made with taper rings; and transition rings were used in changing from light to heavy lining, or vice-versa—the light lining having an 11in. flange and the heavy a 14in. flange. A ring of light lining, assembled, weighs 12·5 tons. The estimated total weight of all cast iron segments in the two tubes is 55,230 tons. This figure includes the cast iron lining for the sump and pump chamber.

Tunnel driving under the river was started from the bottom of the ventilation shaft in Manhattan,

CONWAY MUCKING MACHINE

and from the bottom of a construction shaft close to the site of the ventilation building in Queens; in Manhattan, tunnelling operations were later transferred to temporary construction shafts to the west of the ventilation shaft, permitting the ventilation shaft to be completed. Each tube was bulkheaded near each shaft by a concrete wall 14ft. thick, through which were extended the various locks of different sizes which made it possible to enter and to leave the advancing tunnel sections which were placed under air pressure. The bulkheads were not constructed until the shield for each tube section was assembled and had advanced to a point ahead of the bulkhead site.

Compressed air was used on the Queens side from November 9th, 1937, to December 8th, following, during the construction of bottom drifts prior to shield driving. These drifts were driven with a full rock face, in free air, except for short stretches where the rock surface fell to a level below the drift roof and so required the use of compressed air. The drifts were driven for about 1100ft. westward of the Queens construction shaft. The shields on the Manhattan side were erected at the bottom of the ventilation shaft; and, after they had been advanced into the previously excavated sections of rock tunnel, then the bulkheads were built and these two headings were placed under air pressure—the south tube on April 6th, 1938, and the north tube on May 16th of the same year. By April 21st, 1939, after underrunning the western channel of the East river, the south Manhattan heading entered the rock reef near the middle of the stream and far enough to permit air pressure to be removed; similarly, pressure was reduced to normal in the north Manhattan heading on May 6th, 1939. Shield driving under compressed air was started on the Queens side of the project on June 7th, 1938, and entered the reef in the middle of the river early in October, 1939, when further driving was with full rock faces—compressed air pressure being removed from both headings on October 20th, 1939. As early as practicable, a second bulkhead was placed in each tunnel and double-stage decompression used in locking out, the pressures between locks being kept at approximately one half the gauge pressures at the headings. The second bulkheads were placed in service in the north and south tunnels, in Manhattan, on December 19th and November 14th, 1938, respectively, and in Queens on March 27th and April 19th, 1939, respectively. The distances between locks in Manhattan were, north tunnel, 460ft., south tunnel, 425ft., and in Queens, north tunnel, 705ft., and south tunnel, 735ft. The four opposing headings finally met and were holed through on November 8th of last year. Progress, however, to that point was not without its setbacks.

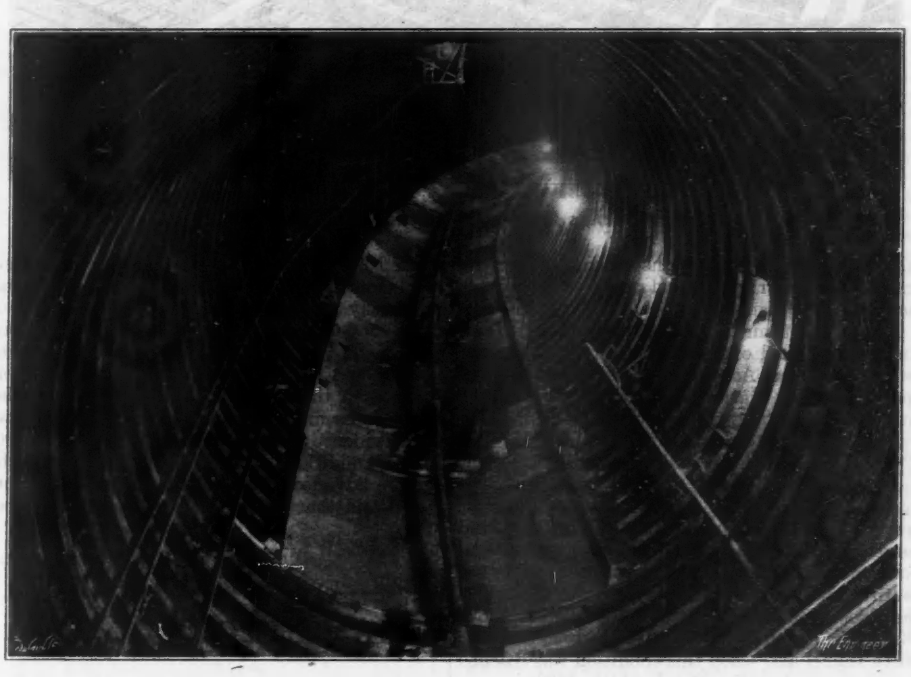
The difficulties encountered during the driving of the under-river section of the Queens Midtown tunnel were caused principally by the large diameter of the heading—the shields being 31ft. 8in. in outside diameter, by the open nature of the glacial drift, riprap, and other materials found in the bed of the river, and by the irregularities of the rock floor, which resulted in a large amount of mixed face and continual variations in the character of the face. An unbalanced head of nearly one atmosphere at the top of the tunnel occurred when balancing the hydrostatic pressure at the bottom, and a clay blanket of suitable expanse and thickness was placed on the river bed to counterbalance the unbalanced head. The point in the face at which pressure was actually balanced depended upon the nature of the material in the face as well as the height of rock, if any, in the face. The maximum pressure necessary did not at any time exceed 37·5 lb.; and full theoretical pressure was not required at points at which the hydrostatic head at the bottom of the tunnel was greater than this figure.

The maximum shield progress, under any ground condition, was made on the Queens side of the project in full rock face in which the previously driven bottom headings had accounted for a large percentage of excavation. Under those conditions, the shield in the north tunnel in Queens was advanced 121·7ft. during the week ending December 17th, 1938. While advancing the shield and excavating a full face of material, the most rapid progress was made from the Queens side through a full face of soft ground. For the week ending September 2nd, 1939, 56ft. of progress was made in the north tunnel, and for the week ending September 16th, 1939, an advance of 53ft. in the north tube, and 56ft. in the south tube was achieved. Progress approaching these figures was also registered in other weeks while driving through soft ground. No unusual difficulties were experienced on the Queens side because of excessive loss of air or the erosion of the clay blanket due to air losses. Progress in a full, unexcavated rock face was much slower in the north tunnel. For example, 21·4ft. was made in the week ending May 13th, 1939, and 27·3ft. in the week following; and corresponding progress in the south tunnel from Queens for the week ending May 13th was 24·1ft. In mixed face, characteristic progress for Queens averaged 27ft. a week for a five-week period including the week ending May 27th, 1939, to and including the week ending on June 24th in the north tunnel; while the contemporaneous performance in the south tunnel was an average of 26·1ft. per week. During that period, in both tunnels, the rock varied in height progressively, from the top of the face, in the beginning, to the bottom, at the end; and the overburden consisted of sand, clay, gravel, boulders, and decomposed rock. Progress was fairly uniform throughout.

The greatest difficulties in driving the headings were met with on the Manhattan side of the East river. Air pressure, which was placed on the south Manhattan heading on April 6th, 1938, was removed on May 2nd, after the shield had passed through a stretch of water-bearing rock. Eight days later, air pressure was again applied in the south heading, and initiated in the north heading on May 16th. Mixed face was encountered in each heading before reaching the river bulkhead. In the three weeks ending June 11th, 1938, progress averaged 20·8ft. a week in the north tunnel, and 17·4ft. a week in the south tunnel. There was a high rate of air consumption due to the open nature of the material overlying the rock. At that time, 194,900 cubic yards of clay had been deposited as a blanket over and in advance of the heading. At the river bulkhead, this blanket extended in height to the low-water level. Air escaped through the blanket at some points, causing erosion and washing away which necessitated a considerable amount of replacement. Excavation in the north tunnel was suspended from 8 p.m., June 16th, 1938 to 4 a.m., June 18th, and air pressure was reduced from 28lb. per square inch to 25 lb. per square inch in an attempt to permit the clay blanket to consolidate. At that time, grouting in the tunnel was brought up as close as possible to the shield. Excavation was suspended for similar reasons in the south tunnel from 8 a.m., June 19th to 6 a.m., June 21st. It should be mentioned that tunnel-driving operations were carried on continuously for six days of each week working 24 hours per diem—the length of shifts being determined by the pressure, according to New York State law, and each shift consisting of two working periods with a rest period in between.

Probably the most serious of the setbacks to progress was due to a fire, still of undetermined origin, which was discovered in the north Manhattan tunnel at 8 p.m., June 26th, 1938, a Sunday, when work was suspended with only watch shifts on duty. The fire had not been observed by the departing shift and was only discovered by the relief watch when trying to enter the tunnel a few minutes later. Despite every effort that could be made to find the seat of the trouble, the heading could not be reached and the flames were extinguished only when the tunnel was flooded sufficiently for that purpose in the morning of June 27th. At the time of the fire, both the north and the south headings were abreast on the Manhattan side.

The materials in the two headings at that time were of an extremely troublesome nature. In the north tunnel they consisted of loose coal, about egg size, in the upper 8ft., with sand, clay, gravel, and boulders next below and downward 2ft. beneath the springing line, and from that level there was decomposed rock to within 7ft. of the invert of the shield, and sound rock from there downward. In the south tunnel there were large stones, riprap, fill, and débris in the upper third of the face, and immediately below there was a layer of silt 2ft. thick followed by sand, gravel, and boulders to about 6ft. below the springing line and overlying 4·5ft. of decomposed rock before meeting sound rock. Air losses had required the operation of seven compressors or about 40,000 cubic feet of free air per minute, together with the continuous dumping of clay from deck scows to take care of blows. The north tunnel heading was not recovered until August 9th, 1938.

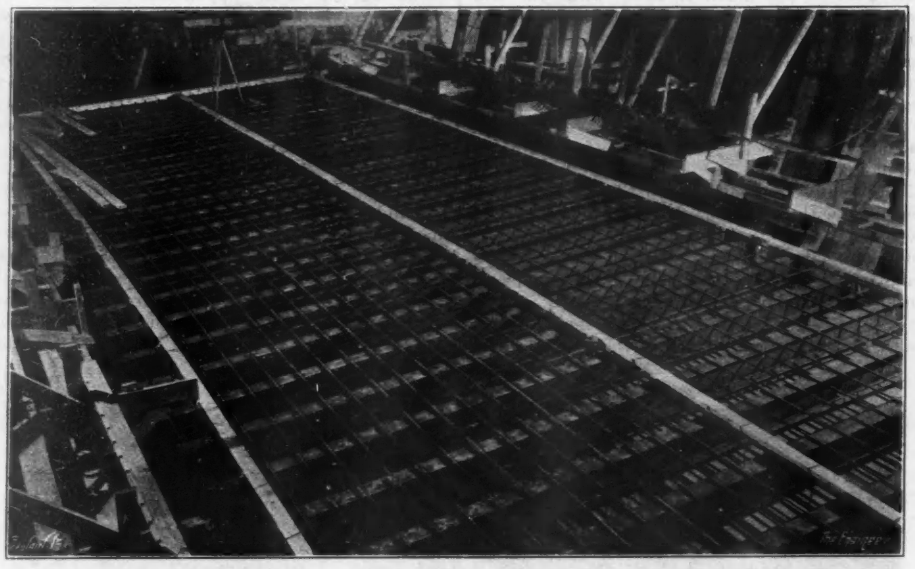


CONCRETING FRESH AIR DUCT INVERT IN NORTH TUNNEL—AUGUST, 1939

Immediately following the fire in the north tube, excavation was suspended in the neighbouring south tube, while grout and gravel were ejected outside the lining and the face was grouted with a mixture of sawdust and Volclay Bentonite. Excavation was resumed in the south heading at 8 a.m., June 28th, 1938, and progress averaged less than 15ft. a week—continuing to use Bentonite and sawdust to grout the face. On Sunday, July 17th, a movement in the breasting at the heading caused the air consumption to rise to a value of 46,500 cubic feet of free air per minute, the full capacity of the Manhattan compressor plant, and was accompanied by a drop in pressure from 29 lb. to 27 lb. per square inch, which was followed by an influx of water which rose to within 9ft. of the top of the shield. Directly after this flooding, it was found possible to advance the shield the width of a ring without excavating—*i.e.*, by a "blind" shove, and the resulting consolidation of the face, so compressed, permitted raising the air pressure and unwatering. It was then found practicable to advance the shield, again without excavation, a length equivalent to one and a half ring widths. Before resuming excavation, the face and the tunnel lining near the south shield were thoroughly grouted with a mixture of Brixment, Portland cement, and natural cement and sand. The total of the deposited material in the blanket at that time amounted to more than 226,000 cubic yards.

Operations to remove the water from the north tube were begun on August 1st, 1938. In an effort to consolidate material outlying that heading eight 2½in. casings were sunk from the river surface

into the river bottom around the shield, and in grouting 4157 bags of Brixment were used in a 1 : 1 mixture with sand. Grout was also forced from a 1½in. pipe which was extended from the south tunnel to the north tunnel. The emergency lock was lengthened 12ft., and the north tube was entered on August 4th, when the water level was below the lock, but while the shield was entirely submerged. Telephone and electric-light wires were strung by men working from rafts. There was no progress in excavating in the south tunnel during the week ending August 6th; but during that time grouting operations to consolidate the heading were carried on, and additional clay was dumped in the blanket.



ROADWAY BEAMS AND RODS—NORTH TUNNEL—AUGUST, 1939

The north tunnel heading was recovered on August 9th; and excavation was resumed in the south tube on August 12th. Normal tunnel operations were started again in the north tube on August 21st, at which time the south heading was about 85ft. in advance of it—having averaged 12·3ft. a week over a period of seven weeks. For the seven weeks following resumption of work, the average progress in the north tube was 13·5ft. per week, and was mainly through soft ground consisting of riprap, fill, sandy clay, gravel, and boulders. Double this progress was made in the south tunnel during this interval; and the top of the shield was at times in the clay blanket above the original river bed. Progress increased in the north tunnel also when this condition was reached during the week ending October 15th, 1938.

To revert to the work done in recovering the north heading and the conditions existing within the tube immediately after unwatering, the first step in the final attempt of the critical operations involved was taken in hand on August 7th, 1938, and consisted of simultaneously pumping down the water while increasing the compensating air pressure so that the water surface could be lowered about 3ft. below the crown at the shield. The men engaged on this job entered the tube through the upper or emergency air lock, embarked on rafts, and took with them lengths of planking, packing material, and clay for forming and sealing bulkheads. They found that air was escaping in large volume up through the outlying ground by way of the joint between the leading ring of the lining and the tail of the shield. The joint was closed with bagging and an ample seal of clay. With that done, they bulkheaded the shield at the rear of the upper pockets and grouted the face as thoroughly as possible through pipes shoved forward through the bulkhead.

With the foregoing operations completed, it was practicable to lower the water by pumping, and to raise the air pressure; and with the water lowered the men were able to bulkhead and to pack the next lower line of shield pockets. Below the axis, the tunnel was found filled with a deposit of muck that diminished gradually until it nearly reached the air-lock bulkhead. Any effort to lower the water below that level initiated at once an inward movement of the muck; and to check that movement a plank bulkhead was driven down through the muck just rearward of the shield. This barrier made it feasible to free the tunnel of water, to raise the air pressure, and to hold the muck in place. The grouting done through the shield pockets stabilised the material of the face so that the packing could be removed from the shield pockets and the mess at the face cleared away. It was then disclosed that the upper part of the breasting and the waling timbers had been charred while some of them had been broken and forced forward and upward into the ground. The débris and stones and boulders at the face were, however, embedded in the strongly grouted area, and it was that condition that enabled the workers to clear the face progressively downward. After unwatering so that a careful examination could be made of the tunnel and its equipment, it was found that bales of hay and bags of sawdust, previously placed on the grouting platform from 50ft. to 60ft. rearward of the shield, had been consumed; and a good deal of planking of the bolting and working platforms from that point forward to the shield had been burned on their upper faces and otherwise damaged. There was little evidence of conflagration farther back in the tube. Conditions warranted the assumption that the fire advanced from the hay toward the tunnel face; and that movement was, in all likelihood, induced by the flow of air outward through the face.

The clearing of the face was a difficult and dangerous task, and had to be done deliberately and with much care. In removing large pieces of rock or other sizable material from the face, clay had to be worked around and behind the piece to fill the cavity progressively so as not to leave a hole that might lead to a blowout surfaceward. Bad boils had occurred in the ground ahead of the south tube before the north tube was unwatered, emphasising the difficult nature of the ground and the care that would have to be taken in recovering the heading of the nearby north tunnel.

The clay blanket required in the east channel of the river over the tunnel line was largely provided by dredging the blanket from the Manhattan side of the river and depositing it on the Queens side of the stream. This work was done through a modification of the Government permit, which, as originally issued, would have required that all clay should be removed to a specified depth from the Manhattan blanket before any blanket could be placed in the east channel. This change in the requirement greatly reduced the total amount of clay necessary for blanket purposes.

Compressed air for the driving of the tunnel with the four shields was supplied by a compressor plant on each side of the river; and each plant had a capacity somewhat in excess of 45,000 cubic feet of free air per minute, at a gauge pressure of 50 lb. per square inch, as called for by the contract specifications. The maximum pressure under which the work was done was 37½ lb. per square inch; and at that pressure consumption was as high as 40,900 cubic feet of free air per minute when the tunnel faces consisted of riprap, sand, and boulders.

The tunnel walls and ceilings are to be tiled; and lighting is to be provided by electric lamps which will be placed in light boxes set at intervals in the tunnel walls just below the ceiling. The arrangement will be similar to that in the Holland tunnel. At one side of the roadway in each tube there is a footpath for the policing force and for emergency use.

The contract for furnishing the cast iron lining for the Queens Midtown tunnel was let to the United States Pipe and Foundry Company, but the actual manufacture of the lining was sublet to Davies and Thomas Company, Bethlehem Steel Company, and the Continental Roll and Steel Foundry Company. The high tensile steel bolts for the lining were manufactured under another contract let to the Bethlehem Steel Company.

The Erection of a 220ft. Wireless Mast

WE illustrate herewith and on page 536 the erection of a mast 220ft. high, recently installed by Airsales Broadcasting Company (Station 2HD) Newcastle, New South Wales. Throughout its entire length the mast consists of 6in. o.d. × 7g. black bore casing in stock lengths with screwed joints, and is the third mast of tubular construction erected by the Broadcasting Company—two others, each 185ft. in height, and also consisting entirely of 6in. casing, having previously been erected in Queensland and South Australia. These masts have been in service for the past two years or so, and have so far proved entirely satisfactory. In each instance the method described below was employed in raising the masts to the vertical position.

Four reinforced concrete blocks, each having a loop made from 1in. round mild steel set into it for the attachment of guy ropes, were situated 80ft. from and at right angles to the central foundation block on which the mast was to rest. The lengths of casing were screwed together and rested horizontally on trestles extending beyond the concrete block on the western side of the site, the first length of casing being a short temporary one, which was stiffened by having wooden battens lashed to it. Nine guy ropes (five permanent and four rigging guys) were then bolted to the guy bands on the mast and secured by hooked rigging screws to the loops of the concrete blocks situated on the northern and southern sides, to prevent side play during the raising process. Guy ropes Nos. 1, 2, 3 and 5 were of $\frac{5}{16}$in. diameter wire rope, consisting of seven strands, and guy rope No. 4 was of ⅜in. diameter, also consisting of seven strands.

A jury mast, 76ft. in height and made from 8in. by 8in. Oregon timber, was connected to the main mast by means of a lug 4in. by 3½in. wide made from ¼in. steel plate, which was welded on at right angles to an 8in. by 8in. by ⅜in. flat plate which rested on the top surface at the lower end of a 7ft. 6½in. length of casing, which formed the temporary first section of the mast. The flat plate formed a seat on which the base of the jury mast rested, the plate being held in position by the hinge pin guide plates, the top edges of which were welded to it. The ⅜in. thick guide plates were inserted and welded into slots at the end of the temporary short length, the end being slotted top and bottom at both sides for a distance of 6½in., the slotting commencing ⅞in. from each side. The 4in. by 3½in. lug was drilled and inserted into the

EASTERN GUY ROPE BLOCK

centre of the jury mast at the base, a ¾in. bolt going through the timber and serving to keep the two masts attached. Oregon timber of 10in. by 10in. or 12in. by 12in. section would have been preferred for the jury mast, but as suitable lengths were not available in these sections 8in. by 8in. material had to be substituted, and bow strings served as stiffeners.

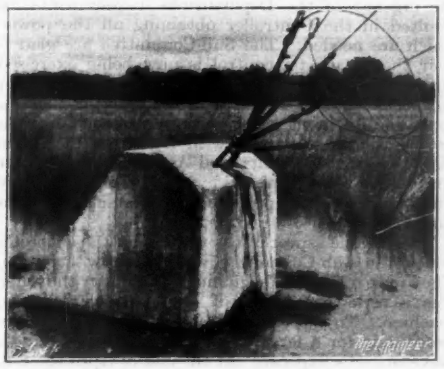
The guy ropes for the eastern side were attached by hooked rigging screws to the top of the jury mast, each guy being adjusted to an even tension, and were

later, when the mast was finally raised, transferred to the loop on the eastern concrete block. A second loop on this block was used in the raising process, a pulley block through which the hauling rope passed being hooked to it. This concrete block was of stouter dimensions than the three other blocks and was different in shape. The hauling rope passed through a second pulley block attached to the top of

BASE FRAME

the jury mast, the hauling being effected by means of a hand winch secured to the base of a stout tree situated approximately 120 yards away.

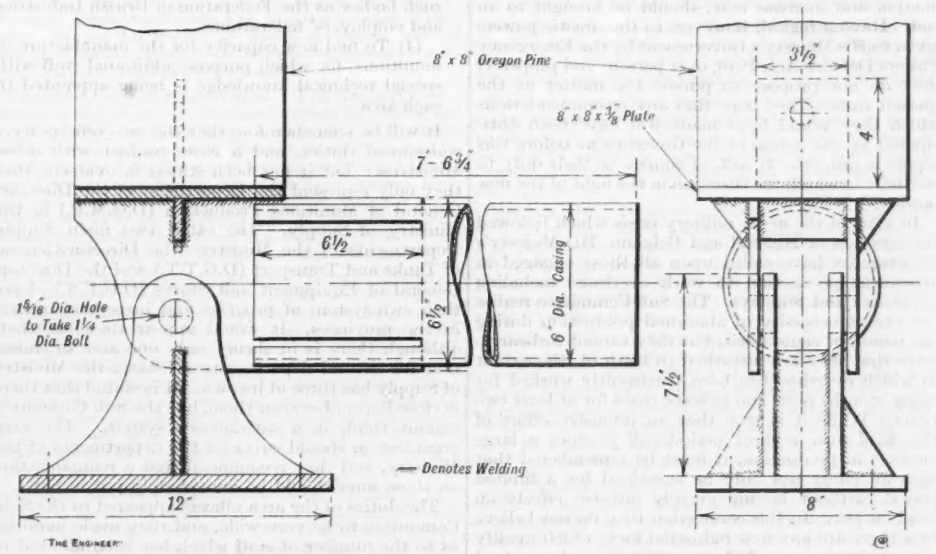
During the raising process one of the lower guys became detached, the result being that the mast was subjected to a very heavy bending stress. The detached guy was replaced and by means of the rigging screw the mast was straightened. Before the mast



ANCHOR BLOCK

reached the point of balance, the guys for the western side, which so far had been hanging loose, were fastened to the loop on the western block. When a truly vertical position was assumed, the mast distorted under the weight of the jury mast, but when the jury mast was detached it immediately straightened out.

The next process was to remove the short temporary length of casing, but before this could be attempted it was necessary to erect a permanent structural steel base frame, the members of which were welded together to form three sides of the frame only, the remaining side being welded on after the others had been placed in position and temporarily secured to the mast foundation block. The Broadcasting Company's engineer, Mr. T. C. Kitto, has since decided that a more convenient method would be to have the structural steel base completely welded together beforehand, and, after being slipped over the mast, lashed to the first section before the raising process is commenced. Later, when the mast is finally raised, the complete frame could be lowered and set in position.

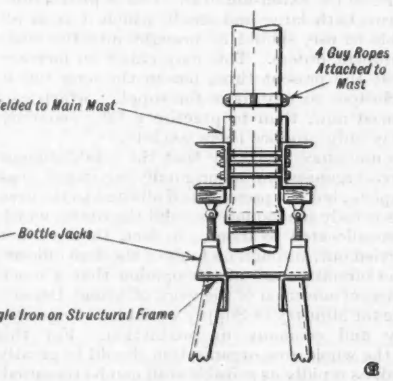


ATTACHMENT OF JURY MAST TO TEMPORARY LENGTH OF CASING

Four auxiliary guy ropes were then attached to the mast slightly clear of and above two lugs consisting of ¾in. square steel, which were welded on *vertically* for a distance of 6in. to opposite sides of the mast, each lug being equidistant from the end of the first permanent section. The auxiliary guys were next attached to their respective anchor blocks and tightly adjusted, to ensure that the mast would be held central with the top of the base frame, which was then permanently bolted to the mast foundation block.

MAST INSULATOR

The stage was now reached for the mast to be insulated and for the removal of the short temporary length of casing, to the bottom of which the hinge pin guides and jury mast base assemblies had been welded. These operations were performed with the aid of two bottle jacks, which were seated on steel plates placed on top of the structural frame at either side. On the tops of the jacks hardwood blocks were placed, and above these two pieces of channel section were securely bolted together, each section being directly beneath and bearing against the shoulders of the two lugs of ¾in. square steel, which had previously been welded to the first permanent section of the mast at opposite points. The jacks were then able to take the weight of the mast, and as the heights of the structural frame, temporary short length of casing and insulator assembly had been carefully calculated beforehand, it was only necessary to raise the mast the slightest fraction in order to remove the hinge pin used during the raising process. The hinge pin base pedestal, on being removed from the mast foundation block, left sufficient space to enable the temporary short length of casing to be unscrewed, after which the insulator assembly was bolted to the top of the structural base frame and the mast lowered to rest on its pin base.



METHOD OF REMOVING TEMPORARY LENGTH OF CASING

We are informed that Airsales Broadcasting Company considers bore casing to be ideal for wireless mast construction, as the swelled joint facing downwards permits water to run down the mast without the possibility of intrusion to the inside, where dampness to the wiring would tend to result in inefficient performance. A mast, 365ft. in height and consisting of 8in. and 6in. casing only, is now in course of construction by the same Broadcasting Company at Atherton, Queensland (Station 4AT).

We are indebted to Stewarts and Lloyds, Ltd., Glasgow, and to their Australian Associated Company for the information contained in this article and for the illustrations accompanying it.

Output of Munitions*

Labour Problems

THE Second Report of the Committee drew attention to the vital problem of the supply of skilled engineers for factories engaged in the manufacture of all kinds of war stores. It was stated that advertisements were appearing in the newspapers, offering bonuses and special attractions in addition to normal remuneration, in order to entice personnel away from their present work. It was pointed out that this continuous movement of labour was bound to have an injurious effect on production, and that an inevitable result is a rise in costs. The Committee did not make any recommendations for the prevention of this practice, but they drew attention to the powers the Government already enjoyed under the Control of Employment Act, and they expressed the hope that the Ministry of Labour would quickly come to some agreement with the employers and the unions on the steps necessary to put an end to a most undesirable and uneconomic state of affairs.

The Sub-Committee have now obtained much more evidence on the prevalence of this competitive bidding for personnel. Letters are continually coming in from manufacturers on the subject, and other letters have also been received showing that the practice is becoming prevalent in the class of unskilled workers employed by Local Authorities. A similar difficulty is arising at collieries, where boys are refusing to work on the grounds that others of the same age, or even younger, are earning higher wages in munition factories. During their visits to Royal Ordnance Factories and other factories engaged on Government

* Excerpts from the Sixth Report of the Select Committee on National Expenditure, May 28th, 1940.

work the Sub-Committee have everywhere met with the same complaint.

It was the Sub-Committee's intention in this report to make recommendations as to the course which they thought it essential should be pursued in order that these practices, which both hinder production and increase cost, should be brought to an end. Having regard, however, to the drastic powers given to His Majesty's Government by the Emergency Powers Defence Act, 1940, over persons and property, they do not propose to pursue the matter at the present time. They hope that any recommendations which they would have made will have been anticipated by the action of the Government before this report is printed. It will, of course, be their duty to continue to watch the situation in the light of the new powers.

In view of the acute military crisis which followed the invasion of Holland and Belgium, His Majesty's Government have called upon all those engaged in armament production to work overtime, including Saturdays and Sundays. The Sub-Committee realise the urgent necessity of abnormal production during the period of acute crisis, but they cannot forbear to state that they are disturbed to learn of the extent to which overtime has been persistently worked for many months past, and in some cases for at least two years. While it is true that an intensive effort of this kind over a short period will produce a large increase in production, it must be remembered that such an effort can only be sustained for a limited period, without having gravely adverse effects on total output. In this connection they do not believe that there are any new industrial facts which modify the conclusions stated above, which were also arrived at by the Health of Munition Workers Committee in 1917. This view is reinforced by the first report of the Industrial Health Research Board this year. The effect of overtime systems of payment leads to an increased cost of production, even if output rises proportionately to hours of labour. In those cases—and the Sub-Committee believe them to be the majority—where output per hour falls when the daily hours exceed the optimum standard, the costs of production must necessarily increase to a far greater extent. The Sub-Committee recommend that this problem should receive the consideration of the Ministry of Labour in conjunction with all the Departments of State concerned with supply.

The Area Organisation

In order to expand production by getting into touch with as large a number of manufacturers as possible, an area organisation has been set up in the provinces. The country has been divided into twelve regions, each under an area officer. Within the last few months the organisation has developed from being a purely departmental one into being an inter-departmental organisation centred in the Ministry of Supply. At headquarters there is a directorate; in the provinces there are twelve Area Boards, consisting of the area officers of the Admiralty, Air Ministry, and the Ministry of Supply and the Divisional Controller of the Ministry of Labour. It is also proposed that a representative of the Board of Trade should be added to watch the interest of the export trade. The duties of the area boards have so far been defined as follows:—

(*a*) To secure the rapid, effectual and continuous co-ordination of the efforts of all Government officials in the area in connection with the production of war stores.

(*b*) To provide for the speedy exchange of information between Ministries and Service Departments and the Area Advisory Committees.

(*c*) To settle by agreement, in so far as is possible, all local difficulties likely to delay output.

(*d*) To transmit to headquarters proposals for the exploitation of additional capacity found in the area.

(*e*) To advise headquarters on the adjustment of difficulties over priority of contracts.

The Area Boards are advised by twenty-three Advisory Committees, each of which consists of an equal number of representatives of employers and employees, nominated by the engineering Employers' Federation and T.U.C. respectively. The terms of reference of these Committees are as follows:—

(1) To advise the Area Board regarding the efficient output of anything required by the Ministry of Supply and the Defence Departments, and to assist the Board in overcoming local difficulties.

(2) To survey the area within which the Committee is working with a view to increasing efficient production in the area.

(3) To consider and make recommendations to the Area Board upon any matter arising out of the terms (1) and (2), except matters which are properly the concern of the Ministry of Labour and National Service, or are normally handled by the joint organisation of employers and trade unions in connection with wages and conditions of employment.

Each area officer of the Ministry of Supply has been allotted the following duties:—

(1) To "progress" Ministry of Supply munitions contracts in this area from the point where the contract reaches the production stage, up to, but not including, inspection.

(2) To assist in the hastening and progress, where asked, of sub-contracts in his area placed by prime contractors situated elsewhere.

(3) To act as liaison officer with area representatives of other Government Departments, with the Raw Material Controls and with representatives of such bodies as the Federation of British Industries and employers' federations.

(4) To find new capacity for the manufacture of munitions, for which purpose additional staff with special technical knowledge is being appointed to each area.

It will be seen therefore that the area officers have widespread duties, and a close contact with other Ministries; but it has been stated in evidence that they only represent the Department of the Director-General of Munitions Production (D.G.M.P.) in the Ministry of Supply. The other two main Supply Departments of the Ministry—the Director-General of Tanks and Transport (D.G.T.T.) and the Director-General of Equipment and Stores (D.G.E.S.)—have their own system of progress and inspection officers in the provinces. It would appear therefore that, although there is in theory only one area organisation for several departments of State, the Ministry of Supply has three of its own. It is stated that there is close liaison between them, but the Sub-Committee cannot think it a satisfactory system. The area organisation should cover all the departments of the Ministry, and they recommend that a reorganisation on these lines should be immediately put in hand.

The duties of the area officers appeared to the Sub-Committee to be very wide, and they made inquiries as to the number of staff which has been allotted to each officer. They were surprised to discover that the average number, excluding the Area Officer himself and typists, messengers, &c., was only five. They then made more detailed inquiries about his duties. They noted that the first duty was to progress munitions contracts from the production stage up to, but not including, inspection. Nevertheless, it was learned that the weekly or fortnightly progress reports made by each contractor are sent direct to headquarters in London, and several days elapse before they reach the area officer, who is nominally supposed to look after the progress of the contracts. Moreover, it appears that progress officers are frequently sent down direct from London without necessarily making any contact with the area officer. They are not therefore in a position to know all the local conditions, and a case has been quoted to the Sub-Committee where the action of a progress officer from London in one factory caused almost a complete stoppage of work in another, of which he had probably never heard. In fact, the Supply Departments of the Ministry are keeping as much of the progressing in their own hands as possible, as was the practice before the area organisation was set up. This puts the area officer in an impossible position. Either he is the progess officer or he is not. At the moment he is in some cases, but not in others. He is not entitled to ask for regular progress reports from the contractors, with the result that by the time he receives the information of any hold-up it is often too late to effect a real cure.

The area officer's fourth duty of finding new capacity for the manufacture of munitions is the one for which the area organisation was originally created. Nevertheless, the "additional staff with special knowledge" has not yet apparently been appointed. This work has been done so far only by the initiative of the officers themselves in making contact with the local trade bodies. Thereby they have been able in some cases to compose a valuable register of all local firms. If the new system is to work satisfactorily, it is all important for the area officers to be given such powers that they may gain the confidence of the local contractors. It seems doubtful whether at the moment this confidence exists. In the present circumstances the Sub-Committee wish to urge the vital importance of the extension of the field of production. Every firm, both large and small, which it is at all practicable to use, should be brought into the orbit of Government orders. This may entail an increase in costs at the present time, but in the long run it will be cheaper to pay more for supplies which can be produced now, than to practise a false economy which may only produce them too late.

It was announced recently that the establishment of the area organisation, as originally envisaged, was now complete, but the present staff allotted to the area officers is utterly inadequate to fulfil the duties which have been allocated to them. In fact, they are not being carried out, through no fault of the area officers. The Sub-Committee are of the opinion that a much greater decentralisation of the work of a huge Department like the Ministry of Supply would lead to greater efficiency and economy in production. For this purpose the whole area organisation should be greatly expanded, as rapidly as suitable staff can be recruited. All the Departments of the Ministry of Supply should be represented by the same organisation. The progressing of contracts should be done by officers who are stationed in the areas and to whom copies of the contractors' progress reports should be sent; but if officers are at any time sent from headquarters, they should have strict orders to report in the first instance to the area officer. They would thus be in a position to know all the facts of the situation, and able to realise the repercussions which any action taken to speed up a particular contract may have on other contracts. It would appear that active steps are now being taken to deal with some of the weaknesses which exist in the area organisation and its relation with the production departments. Accordingly, it will be the duty of the Sub-Committee to examine the situation afresh when the reorganisation which they deem to be urgently necessary has been completed.

Machine Tools

In view of the adverse comment by the Estimates and Public Accounts Committees in recent years on the attitude of the Machine Tool Trades Association with regard to costing, the Sub-Committee took an early opportunity of examining the position. They heard evidence from representatives of the Association, and they are satisfied that the attitude of this trade is now in line with Government policy.

The Sub-Committee have also heard evidence from the Controller of Machine Tools. The production, importation, and marketing of machine tools is subject to an order made at the beginning of the war. Under it, drastic powers have been taken in order to provide against every emergency. Up to the present time, however, only some of the powers have been exercised, and the complete control of orders has not been undertaken. The reasons against this step being taken are two. First, the majority of machine tools now on order are being paid for by the Government under the various expansion schemes, and therefore the Directors of Production involved are directly concerned with this planning. They must be responsible for all such orders, and in the Controller's opinion it would not be practicable for him to be responsible, although he is always accessible for consultation, as to the availability of machines. Secondly, a considerable measure of control is exercised over the orders of machines for non-war purposes by the Controller's power of allocation. This is freely exercised in consultation, on the one hand, with the makers and agents whose order books are open to inspection, and, on the other hand, in the settling of priority requirements by the Inter-Departmental Committee presided over by the Controller.

The Ministry claim that this system is effective to a high degree and avoids all the complications and delays of a system of licensing purchases, such as was in force in the last war. They say that the Inter-Departmental Committee is working well, and that the urgency of the Departments' requirements has resulted in the Controller obtaining all the powers which are needed. The Sub-Committee are glad to hear that a stricter control is now being exercised, but they wish to urge the necessity of very close contact between all the Departments ordering machine tools, and to emphasise the necessity of the Controller having the same powers with regard to the orders placed by the Admiralty and Air Ministry as he has with regard to those placed by the Ministry of Supply. The Sub-Committee propose to re-examine the situation in a few weeks' time.

There is one aspect of the working of the control to which the Sub-Committee wish to draw attention. They were told at the beginning of February that there was a serious shortage of one particular type of machine. To meet this situation negotiations were proceeding for a large expansion of a factory at the Government's expense. At the end of April the Sub-Committee visited this factory and were surprised to learn that no agreement had yet been reached. The negotiations had been going on for seven months. If the situation with regard to this machine was really as urgent as it was said to be, it seems to the Sub-Committee that the prolongation of the negotiations is very serious. A delay such as this may lead, not only to a serious hold up in production of munitions, but also to a consequent great increase in costs. Even if it should be decided to make up the deficiency by the importation of the machines from America, it would surely be a more far-sighted policy to expand the capacity for their manufacture in this country, with a view to future saving and efficiency, and in view of the danger that the American supply may cease to be available. The Sub-Committee understand that work has now been started on the extension of the factory, but they consider it unfortunate that such a delay should have occurred.

Payment of Lodging Allowances and Travelling Expenses.—The Ministry of Labour and National Service announces that workers who are transferred in future by the Department to a new area to undertake work of urgent national importance may, in certain circumstances, be entitled to receive lodging and travelling allowances. Lodging allowances, payable by the Ministry, will be given only to a married worker (or an unmarried worker with similar responsibilities) who continues to maintain a home in the town from which he is transferred, and where the employer to whom he is transferred does not pay lodging or similar allowances under customary practice or industrial agreement. The lodging allowances will be at the rate of 3s. 6d. a night (including Sunday), and will be payable only in those cases where the new place of work is beyond reasonable daily travelling distance from the worker's home. It will be a condition of the payment of lodging allowances that the employer will be responsible for providing certain free fares, and for the payment of travelling time at the beginning and end of the job. Employers and workers interested may obtain further information at the Department's local offices.

Rail and Road

RAILWAY LOCOMOTIVES AND WAGONS FOR FRANCE.—On Friday, May 24th, as recorded in a Journal note in our issue of May 31st, the Director of Transportation and Services accepted delivery of the first of a large number of locomotives for the use of the British Expeditionary Force now in France. The engines were of a modified standard 2–8–0 L.M.S. type and not also of the G.W.R. type, as mentioned in our Journal note.

MOTOR VEHICLE INSURANCES.—The Secretary to the Ministry of Transport makes the following announcement:—Since September, 1939, insurers have agreed for periods of three months at a time to continue and extend, without any general increase in rates, existing policies for "grouped" motor goods vehicles, although the Emergency Powers (Road Vehicles and Drivers) Order, 1939, removed certain restrictions on A, B, and C licences under the Road and Rail Traffic Act, 1933. This arrangement was extended until May 31st, 1940, and the Minister is glad to announce that the insurers have now agreed to extend the arrangement until August 31st, 1940.

MOTOR REPAIR WORKS AND GARAGES.—In a statement made to the motor industry, in association with the President of the Motor Agents' Association, Mr. William E. Rootes, the President of the Society of Motor Manufacturers and Traders, says that the Commander-in-Chief of the Home Forces has asked him to warn the motor industry's repair shops and garages that in the event of hostilities within Great Britain their utmost services would be required immediately in the matter of servicing and maintaining on the roads the vehicles of H.M. Forces. Especially would the motor industry's personnel render invaluable aid by remaining at their posts so long as there is need for their services in any district.

AUXILIARY WATER TANK CARS FOR GOODS TRAINS.—The Missouri Pacific Railway, which in 1926 began the practice of using auxiliary water tanks on its goods trains, has steadily adopted the use of such cars, with a present total of eighty-seven of them in actual service, which on the average each travel more than 6000 miles per month. The water tank cars and the tenders have common connections. By using auxiliary water tank cars trains can be kept in service from eight to ten hours without having to take in water, while additional savings have, it is claimed, been effected, in that the present turntables and engine-houses have been used, which would not have been possible had it been necessary to employ larger and longer tenders.

THE BATON ROUGE BRIDGE.—According to recent reports received from America, good progress is being made with the erection of the 3326ft. multiple cantilever type bridge, which is being built at Baton Rouge for the Louisiania State Highway Commission by the Bethlehem Steel Corporation. The steel erection is now about complete and the pouring of the concrete deck, which was started in April, should be completed by the end of this month. The bridge has two 490ft. anchor spans at the ends and a central anchor span of 650ft. The other two spans are each 848ft. long, and each consists of two cantilever arms of 226ft. supporting between them a suspended span, 396ft. in length. The entire structure is 3326ft. long, and is symmetrical about the centre line. A clearance of 65ft. above high water is provided. The trusses are 124ft. deep at the piers, and 62ft. deep at centres of spans between the piers. The trusses are generally of the subdivided Warren type.

NEW AMERICAN ROLLING STOCK AND LOCOMOTIVES.—According to a report issued by the Association of American Railways, covering the first three months of the present year, Class I railways in the United States placed in service 20,253 new goods wagons. That number is the largest since 1930 to be installed in any corresponding period, and it marks an increase of 15,149 compared with the first quarter of 1939 and of 15,891 compared with the first quarter of 1938. In the same period the number of steam locomotives which were put into service was sixteen. That figure compares with eight in the first quarter of 1939 and sixty-eight in the same period in 1938. New electric locomotives and oil engine driven locomotives numbered sixty-three, compared with forty-six in the same period last year and forty during the same three months two years ago. Further figures show that on April 1st last there were 21,112 new goods wagons on order for the Class I railways, a figure which compares with 6502 for the same day last year and with 5825 for the same day two years ago. There were on April 1st fifty-nine new steam locomotives on order, compared with sixty-two on April 1st, 1939, and eighty-four on the same date in 1938. There were on April 1st fifty-six new electric and internal combustion locomotives on order, which compares with thirty-three last year and nineteen two years ago.

CANADIAN THREE-SPAN BRIDGE.—An interesting three-span double-track bridge carrying the Canadian National Railway over a road near Coaticook, Quebec, has, according to the *Railway Age*, recently been completed. It is low in cost on account of the extensive use of pre-cast concrete slabs for the deck of the main span and the adoption of pre-cast concrete piles with concrete caps. For the approach spans of this particular bridge second-hand deck plate girders were employed. The centre span has a clear opening of 32ft. between the faces of the pier caps and consists of pre-cast reinforced concrete slabs, 38ft. long. The two approach spans consist of second-hand plate girders, 28ft. 8in. long. The overall length of the structure between the faces of the abutments is 96ft. 8in. The piles used in the piers are each 16in. square and 25ft. long. Each pier incorporates eighteen piles arranged in two parallel rows of nine. The enclosing cap for the top of the piles is cast in place and has a length of 29ft., a depth of 4ft. 2½in., and a width of 6ft. An attractive feature of the design is the panelling formed by means of grooves arranged in rectangles. They are used on the faces of the piles and the caps. The abutments are carried by twenty piles arranged in three rows, which are of the buried type with short wing walls. Footways are provided on each side of the bridge at the track level and are protected with an iron fence running the length of the bridge.

Miscellanea

MINISTRY OF SUPPLY APPOINTMENT.—The Minister of Supply has appointed Mr. Alexander S. MacLellan to be Director-General of Ammunition Production in the Ministry of Supply. Mr. MacLellan was engineering director of Alexander Stephen and Sons, Ltd., and is a member of the Council of the Institution of Naval Architects and a member of the Management Board of the Engineering and Allied National Employers' Federation.

WASTE SALVAGE AT FORD WORKS.—A particularly comprehensive system of waste salvage has been introduced in the Ford factory at Dagenham. A sintering plant, which has been installed, makes it possible to produce many tons of pig iron from fine metal borings and filings. This form of waste is too fine to use in the blast-furnace, but when fused together to form a heavy sinter or clinker is of considerable value in the production of high-grade iron. All machine lubricants and cutting fluids are cleaned of minute scraps of metal by magnetic means and reused.

HOARDING OF OXYGEN AND NITROUS OXIDE CYLINDERS.—The Ministry of Health and the Department of Health for Scotland wish to remind hospitals, private individuals, and industrial concerns that it is contrary to the national interest for them to hoard oxygen and nitrous oxide cylinders, whether filled or empty. There now appears to be a renewed tendency to hold undue supplies. The adequacy of the existing supplies can only be ensured if cylinders are not held in excess of actual requirements and if they are kept in constant circulation. Empty cylinders should be returned with the minimum of delay to the suppliers by whom they were issued.

CONTROL OF WAR PRODUCTION.—The Ministry of Supply has issued the Control of War Production (No. 1) Order, 1940, under which some 1500 firms are declared controlled undertakings. The names of these firms will not be published, but a letter will be sent to each firm concerned informing them that they are "controlled undertakings." Those firms will be subject to directions issued by or on behalf of the Government Department for which they are working, usually the Admiralty, the Ministry of Aircraft Production, and Ministry of Supply. Directions have been given to those firms included in the Order to continue with their work in accordance with existing arrangements until they are instructed otherwise.

FINANCING MUNITIONS CONTRACTS.—In reply to a question in the House of Commons, the Chancellor of the Exchequer, Sir Kingsley Wood, said:—"All causes of delay in the production of munitions must be eliminated. In some cases firms, whether Government contractors, sub-contractors, or others, concerned in munitions production may find themselves handicapped by the lack of money for wages and materials. This possible difficulty is fully appreciated alike by the Government and by the banks, and measures have been completed to meet it when it arises. Contractors, sub-contractors, and others are advised to consult their banks when necessary. The system of progress payments while the work is going on, which is a common feature in Government contracts, is being extended to the fullest extent necessary. Government contractors and sub-contractors are requested to see to it that firms with whom they place sub-contracts receive payments on account in the same way."

THE LATE SIR JOCELYN FIELD THORPE.—The death is announced of Sir Jocelyn Field Thorpe, D.Sc., Ph.D., F.R.S., who for many years was Professor of Organic Chemistry in the University of London and was a Past-President of the Chemical Society and the Institute of Chemistry. Professor Thorpe, who retired in 1938, was sixty-eight years of age, and he died on Monday, June 10th, at his Sussex home, The White House, Cooden Beach. He was educated at Worthing College and continued his scientific studies at King's College, the Royal College of Science, London, and the University of Heidelburg. From 1896 to 1910 he was a lecturer in organic and biochemistry in the University of Manchester, after which he became the Sorby Research Fellow of the Royal Society. From 1914 to 1938 he was Professor of Organic Chemistry in the University of London (Imperial College), and on his retirement became Emeritus Professor. He served on numerous Government Committees and was a member of the Safety in Mines Committee, Chairman of the Explosives in Mines Committee, and member of the Dyestuffs Development Committee of the Board of Trade. He received the honour of C.B.E. in 1917 and was knighted in 1939. His published works included books on "The Synthetic Dyestuffs, Vat Colours," and a "Students' Manual of Organic Chemical Analysis." He was co-editor of Thorpe's "Dictionary of Applied Chemistry" and joint editor of supplementary volumes. Many of his publications are to be found in the *Journal* of the Chemical Society.

THE TANK COMMITTEE.—In a speech made in the House of Commons on Tuesday, June 11th, Mr. Herbert Morrison, answering a question as to the arrangements in the Ministry of Supply with regard to the production of tanks, referred to the recently appointed Tank Board, reference to which was made in one of last week's Journal notes. The Board, he said, was composed of independent members and of members representing the War Office and the Ministry of Supply. It had been thought advisable that before the full Board was constituted the independent Chairman and the independent members should review the existing position as far as possible. That had now been done, and, in addition to suggestions as to various matters of less importance, the Board had made two major suggestions. These were, first, in order to secure quick production in these times, the control of the Tank Department in the Ministry of Supply must be in the hands of civilians now engaged in rapid commercial production methods; secondly, that the Army must state its demands unequivocally through one focal point, and that there should be therefore appointed in the War Office a general officer of high rank and recent fighting experience with tanks to perform that function. The Secretary of State for War (Mr. Anthony Eden) and the Minister of Supply (Mr. Morrison) were agreed in principle that these suggestions should be adopted. They will be carried out as expeditiously as they can, always having regard to the fundamental necessity of expanding current production to the utmost.

Air and Water

THE U.S. LINER "AMERICA."—As a result of the uncertainties involved in her operation, the United States Lines Company is reported to have stated its unwillingness to take over the new 30,000-ton liner "America."

SEARCHLIGHTS ON GERMAN FIGHTER AIRCRAFT.—In the course of a recent night raid over territory occupied by the enemy, a British bomber was attacked by a German fighter which played a searchlight on the raiding machine.

MOSCOW AND TRANS-SIBERIAN AIR LINE.—A new regular air service between Moscow and Irkutsk is being maintained by the mail planes, which cover the entire route of 2820 miles from Moscow to Irkutsk in 19 h. 45 min., stopping at Kazan, Sverdlovsk, Omsk, Novosibirsk, and Krasnoyarsk.

PROPOSED DRY DOCK FOR NEW YORK.—A report of the Port of New York Authority to the United States Navy Department recommends the construction of a dry dock of sufficient size to accommodate the largest ships. The proposed dock would be 1100ft. long with allowance for extension to 1200ft., and its estimated cost is between 12 and 18 million dollars.

AMERICAN SHIPBUILDING FACILITIES.—According to a recent survey of the private shipbuilding facilities which now exist in the United States of America, made by the National Council of American Shipbuilders, there are eighty-three building berths, each with a length of 300ft. or over. They are situated at various sections of the sea coast. In addition, there are also thirty-seven building berths in a partially dismantled condition.

THE LIFEBOAT SERVICE.—In his speech at the annual meeting of the Royal National Lifeboat Institution Sir Godfrey Baring said that from the outbreak of war, on September 3rd, to the end of the year, lifeboats were launched on service 419 times. They rescued 1001 lives, an average of 59 every week. In the year 1939 the number of launches on service and the number of lives rescued were both the largest in the history of the Institution.

MERCHANT SHIPPING LOSSES.—It is announced that the British mercantile marine losses during the week ended June 2nd totalled 78,715 tons, but of this, 24,000 tons were lost during the operations off Dunkirk and are not mercantile losses in the ordinary sense. Losses for the week are accordingly given as eleven British ships of 54,715 tons, four Allied ships of 17,913 tons, and three neutral ships of 7923 tons. Up to Wednesday, June 5th, 23,000 British, Allied and neutral ships had been convoyed in British convoys with a loss of thirty-two ships, giving a loss ratio of one in 719. Neutral ships convoyed totalled 3163, with a loss of three, or one in 1054.

TENNESSEE RIVER IMPROVEMENT WORKS.—Work is shortly to begin on the construction of the Fort Loudoun dam on the Tennessee River. When completed the new dam will be 135ft. high, have an overall length of 3900ft., create a reservoir 50 miles long, and provide a 9ft. navigation channel from the Ohio River to Knoxville. This 25 million dollar project was originally known by the Tennessee Valley Authority as the Coulter Shoals. The title Coulter Shoals, derived from a section of the Tennessee River selected as a possible site in preliminary surveys, is no longer applicable for the present location, which is some 45 miles below Knoxville on the Tennessee River. Fort Loudoun, said to be the oldest structure of historical significance built in Tennessee by English-speaking people, was located in the vicinity of the present dam site.

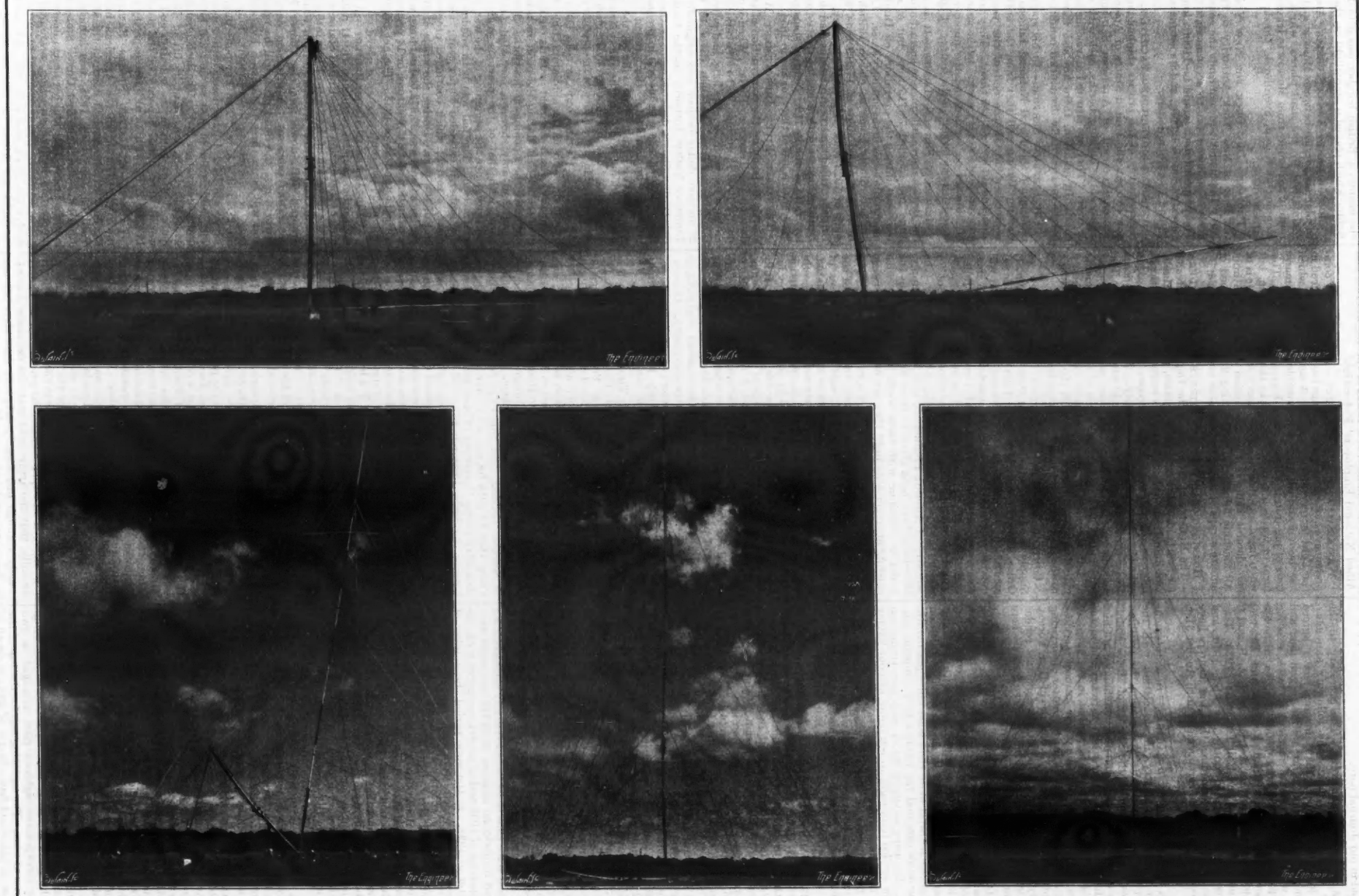
THE SUEZ CANAL COMPANY.—In the report submitted by the directors at the annual meeting of the Suez Canal Company, which was held in Paris on Monday, June 3rd, it is stated that during the eight months which in 1939 preceded the opening of hostilities, the traffic of the Canal had only shown a very slight reduction as compared with that of the previous year. It has, on the contrary, since the beginning of the war, suffered a serious contraction. The fall was both sudden and acute. For September it exceeded 50 per cent.; then a revival took place, a revival which continued progressively until the end of the year. During the whole of 1939 the traffic of the Suez Canal was 29,573,000 net tons, with 5277 transits, a reduction of 4,845,000 tons, or 14 per cent., as compared with the tonnage of 1938. The net profits show a reduction of 36 per cent.

A BIG AMERICAN RIVER PROJECT.—A large power and navigation project, costing nearly 41 million dollars, now under construction in the United States, in South Carolina, is the diversion of the Santee River into a reservoir formed in the Cooper River watershed from which water can be dropped 70ft. down into the Cooper River for power generating purposes. A diversion dam on the Santee River across the flood plain will be nearly 8 miles long, and will be in three sections—a hydraulic fill 4·3 miles long, a concrete spillway 3400ft. long, and an earth-fill 2·8 miles long. The Pinopolis dam on the Cooper River will be 2·1 miles long, with a maximum height of 78ft. and in the highest section will have a power plant and a navigation lock. The lock chamber will be 60ft. wide and 184ft. long, and its lift of 75ft. makes it the highest of its kind in the country, and probably in the world. The initial capacity of the power plant will be 173,300 H.P., with an ultimate capacity of 213,300 H.P.

LAUNCH OF UNITED STATES BATTLESHIP "WASHINGTON."—The 35,000-ton American battleship "Washington," which was laid down in the Philadelphia Navy Yard on June 14th, 1938, was launched on Saturday, June 1st. She is the first United States battleship to be launched since 1921 and her design incorporates the latest progress in hull construction, armoured protection and gun armament. She is designed to carry nine 16in. guns, twelve 5in. guns, and eight 5in. anti-aircraft guns. Two catapults are fitted for the launching of four aircraft. The propelling machinery is being supplied by the Westinghouse Company and will comprise a four-screw arrangement of geared turbines, taking steam from water-tube oil-fired boilers of a new pattern. A designed speed of 28 to 30 knots is expected. Speaking after the launching ceremony, Senator Walsh, the Chairman of the Senate Naval Committee, announced that another battleship would be launched this month, and that six others are under construction.

STAGES IN THE ERECTION OF A 220-FOOT WIRELESS MAST AT NEWCASTLE, N.S.W.

(*For description see page 532*)



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IMPORTANT NOTICE

EDITORIAL AND PUBLISHING

The Engineer, which from the end of August, 1939 until the end of May, 1940 was printed by William Clowes & Sons, Ltd., Beccles, is now again being printed by George Reveirs, Ltd., 10, Rosebery Avenue, E.C.1.

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CHANGES OF ADDRESS.

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GERMANY'S OIL CONSUMPTION AND SUPPLIES

To what extent is Germany consuming her supplies of petrol and oil in the present intensive phase of the war? The answer to this question, if it were known with a fair approach to accuracy, would be of the greatest interest, for it is commonly believed that a shortage, or the exhaustion, of these supplies will prove one of the decisive elements in the enemy's defeat. Unfortunately, any attempt to answer this question can only be founded on calculations which, for certain of their vital data, must involve a considerable measure of guesswork. The difficulties in the way of forming a reasonable estimate of Germany's present rate of consumption of oil will be apparent from a simple list of the principal directions in which she is consuming it. In the first place, there are her aircraft and the mechanical transport serving her air force. This source of consumption will draw almost entirely on the enemy's supplies of petrol for there is evidence to the effect that the Germans have found it advantageous to discard the heavy-oil aero-engines on the development of which they had spent much time and money in the years before the outbreak of war. Next we have the tanks—light, medium, and heavy—which the enemy is using in very great numbers, and the hordes of tanker lorries required to carry fuel from the advanced depots to the units in the field. It is probable, but by no means certain, that petrol forms the bulk of the consumption in this direction. Then we have to take into consideration the needs of the mechanised artillery, the mechanised infantry, and the vast fleets of army service vehicles. Petrol, again, will be the main form of fuel consumed. There are numerous other directions in which the enemy's efforts are dependent upon oil supplies, the principal remaining sources of consumption being her submarines and other naval vessels, her sea transports, her agriculture, and her war industries. Complex, however, as the field of investigation may thus appear to be, it is nevertheless possible, by studying one section of it—the aeronautical side—to arrive at a rough idea of what Germany's present consumption of oil amounts to in that section and, by reasonable inference therefrom, what it probably amounts to on the whole.

To estimate the amount of petrol now being consumed by the German air force in its field operations it would appear to be necessary to know three basic figures—the average consumption per aeroplane per hour, the average number of hours per day each machine spends in the air, and the average number of aircraft employed from day to day. We can, however, avoid the difficulties involved in assessing the first and second of these factors by approaching the problem in another way, namely, by studying the tank capacities and durations of Germany's leading aircraft types. For instance, the Heinkel 111 twin-engined bomber has a tank capacity for 6550 lb. of petrol and a duration of 9½ hours. It is unlikely that such a machine, even under conditions of intensive warfare, would be employed on flights aggregating more than 9½ hours in the air per day. At one refuelling in twenty-four hours we may therefore assess the consumption of this class of enemy aircraft at about 2¾ tons per day. The Dornier 17 "Flying Pencil" twin-engined bomber has a fuel tank capacity of 4300 lb. and a duration of six hours. This machine might be refuelled twice in twenty-four hours, but it seems safer to take it that the refuellings on the average are made at the rate of three in two days. The daily consumption on this basis would be 6450 lb., or 2¾ tons, the same as that of the Heinkel 111. The Junkers 86 twin-engined bomber carries 2840 lb. of fuel, and has a duration of 4½ hours. It is reasonable to suppose that this machine would be refuelled twice per day. Hence its consumption may be placed at 5680 lb., or 2½ tons per day. The Heinkel 112 single-seat fighter carries about 1000 lb. of fuel and has a duration of 2¾ hours. Such a machine might be refuelled at least three times and, under intensive fighting conditions, even four times a day. Its consumption may therefore be placed at 4000 lb., or 1¾ tons per twenty-four hours. The Messerschmitt fighters and reconnaissance aircraft, such as the Henschel 126, may be entered at the same figure. From these data it may be asserted with considerable show of reason that, under conditions of intensive warfare, the average fuel consumption for all classes of German aircraft is of the order of 2 tons per day. It is certainly not likely materially to exceed that figure. It now remains to estimate the average number of aircraft employed by the enemy on actual war operations from day to day. Some days ago, when the German aircraft losses in Holland, Belgium, and France since May 10th were stated to total 1600, it was asserted that they represented one-sixth of her total air strength, thereby implying that that strength was about 10,000 aircraft. If this figure is in any way accurate it probably relates to first-line aircraft only, and excludes the large number of training machines which Germany, like ourselves, possesses, and which also consume a far from negligible amount of fuel. Taking the figure as representing the enemy's first-line strength we may assume on a conservative basis that at any one instant out of every five machines possessed by the Luftwaffe one will be in the air and four on the ground. On this basis the average number of aircraft engaged from day to day on active operations may be taken to be in the neighbourhood of 2000. This figure is in fair agreement with independent estimates reported from French sources. Taking it as being substantially accurate we may estimate that the average consumption of petrol by the active battle units of the German air force totals about 4000 tons per day. We may safely add one-eighth or so to this figure to cover the fuel used by the training machines and by the vehicles servicing the aircraft. Thus Germany's present air effort would appear to involve the consumption of at least 4500 tons of petrol daily.

Turning now to the enemy's tanks we might safely say that the total consumption of fuel is certainly not less than that of her aircraft. The average horse-power of the German tanks of all classes is probably of the order of 500 or more. At ½ lb. of fuel per horse-power hour and an average daily employment of ten hours the consumption would amount to roughly 1 ton of fuel per tank per day. If, then, we take the total consumption of fuel at the same figure for the tanks as for the aircraft, the implication is that Germany has in day-to-day use some 4500 tanks of all classes. This figure is again in reasonable agreement with independent estimates of the number with which the enemy began the Low Countries campaign, although since it opened heavy losses have undoubtedly been suffered and it is uncertain whether they have been completely made good. The probable consumption of fuel by German aircraft and tanks would thus seem to amount to a figure of the order of 9000 tons per day. As to the consumption by the vehicles of the mechanised artillery and infantry and by the army service departments, we have nothing but guesswork upon which to rely. Nor can we form any reasoned estimate of the amount of fuel consumed by Germany's naval and transport vessels or in her agriculture or her war industries. Few, however, will be disposed to dispute the assumption that the total quantity of fuel oil used in these various directions is equal to, at least, half the combined aircraft and tank total. If we accept this assumption we may say that the grand aggregate of Germany's demand on her oil resources under conditions of intensive warfare is of the order of 13,500 tons per day, or at the rate of 5 million tons per annum. This figure, it should be noted, relates to fuel oil to the exclusion of lubricating oil, a commodity a deficiency of which would wreck the efficiency of the German war machine almost as decisively as a deficiency of fuel oil.

We may endeavour to round off this survey by presenting an estimate, however rough, of the resources of fuel oil available to the enemy. These resources fall under four heads:—Imports from countries at present outside Germany's rule or control; production within her own boundaries and those of the countries which she has invaded; the stocks accumulated within Germany before the outbreak of war; and the

stocks seized in the invaded countries. Vast stocks of fuel oil are stated to have been accumulated in Germany before the war began, but, unless they were imported secretly, a study of the peace-time import and internal consumption figures suggests that the amount of these reserves may be less than the three to four million tons mentioned recently by a French authority. The supplies seized in the invaded countries were certainly of considerable magnitude. In Denmark and Norway alone the amount of oil obtained by seizure has been estimated at about 500,000 tons although it should be noted that the bulk of it would be heavy fuel oil and not petrol. While it is impossible to place a reasoned figure on the oil stocks within Germany or seized by her in the countries invaded, two comments can be made concerning them. In the first place they are essentially in the nature of reserves and once used cannot be replaced. Secondly, they are open to destruction by attack from the air. How much of these stocks Germany has already lost in this way cannot be stated with the least authority. But that the loss is already very considerable seems certain in view of the repeated attacks which the Royal Air Force has carried out apparently with much success on oil and petrol tanks in the invaded countries and within German territory itself. For instance, a recent Air Ministry announcement stated that following a raid on petrol and oil stores at Rotterdam on June 1st, it is believed that all these plants have now been totally destroyed. Since that date numerous storage tanks and oil refineries at Ghent, Hamburg, and a number of other centres have been attacked almost nightly. Mr. Hugh Dalton, the Minister of Economic Warfare, in a recent broadcast speech has referred to the "tremendous effect" of the R.A.F.'s bombing of oil storage tanks and coal-oil plants in Germany. Either by usage or by action on the Allies' part it is certain that sooner or later Germany will be dependent for her oil supplies solely upon what she can import and what she can produce within her own and her subjugated territories. The question we have really to answer is therefore this: Can she continue indefinitely to obtain or produce petrol and fuel oil at the rate of 5,000,000 tons per annum? If we are to believe certain figures which have been published the internal resources of Germany proper are by themselves sufficient to supply the whole of that amount. The Bergius and Fischer-Tropsch processes of hydrogenation are, according to these figures, capable of producing between them 2,570,000 tons of oil products, while the distillation of brown coal, coal tar cracking, and other processes, yield together a further 1,580,000 tons. In addition she can, it is said, obtain 1½ million tons of crude oil per year from her own and from the Polish oilfields. These figures seem to be exaggerated, especially those relating to the hydrogenation processes. In any event, all the products covered by them are certainly not petrol. If we divide them by two and speak of the result as constituting the petrol available to Germany from her own internal resources, we shall still in all probability be overestimating the amount at her disposal from these various processes. On that basis she would still have to find a balance of two to three million tons per year from external sources. That Russia or Roumania separately could supply that amount to Germany can be accepted without hesitation, but whether they will do so involves political and economic considerations which are outside our scope, and transport problems of great difficulty.

It may be objected that the figures we have given for Germany's petrol and oil consumption assume the continuation of intensive warfare for an indefinite period, whereas strategical considerations—to say nothing of the weather—may lead to periods of intensive warfare alternating with quieter periods during which the rate of consumption would fall off. This contention is well founded although we must hesitate to assess its significance for the purposes of the present argument. In any event, so far as it reduces our estimate of the enemy's average demands on his oil and petrol resources it but emphasises the plain fact which emerges from our survey. Vast as may be the consumption of petrol and fuel oil by Germany in a campaign of the present intensity we have failed to discover any reasoned basis for the belief that her collapse through shortage of these supplies is likely to occur within the measurably near future. The advantage as regards access to sources of liquid fuel undoubtedly lies with the Allies. That advantage can be made decisive, but we must rely not on the exhaustion of the enemy's supplies, but on the exploitation of our own in ever-increasing measure.

Glass Fibre Electrical Insulation

By R. QUARENDON, Ph.D., B.Sc.

THE last few years have witnessed considerable advances in the technique of the production of glass fibres, with the result that they are now finding application in several fields. To a large extent the improvement in mechanical properties to which its extended use as a medium for heat insulation and in chemical engineering is due are also proving of value for electrical insulation. A number of very interesting developments have taken place in this direction during the last two years.

Glass fibres were first produced on a large scale by Germany during the last war when she was deprived of the usual insulation for the boilers of her warships. Germany used the Gossler process, in which the fibres were drawn by mechanical means from glass rods. Although the glass insulation served its purpose as a substitute material, both the fibres themselves and the method of producing them were far from satisfactory. The fibres produced in this way were much too harsh and brittle to find permanent favour in competition with the conventional materials and could not be produced on an economic basis. The process lapsed, and it was not until the American Owens-Illinois process was introduced at the beginning of the present decade that glass fibre insulation began to make headway on a commercial basis. The last five years have seen a steady growth in its use for numerous purposes. The chief problem which the Owens-Illinois process helped to overcome was the production of a fine enough fibre at a sufficiently high rate of output. A blast of air or steam is blown across molten streams of glass issuing from many tiny holes in a heated metal plate and deposits them on a moving band. A staple fibre several inches long is thus produced which is gathered together into a continuous sliver which is then spun and twisted into a yarn. Yarns of various sizes are woven into fabrics in the form of ribbons, tape or cloth, or the yarn may be used as it is for winding direct on to wire.

Made in this way the fibre has a greater resemblance to wool than to silk, and the product is usually known as glass wool. It is also possible, however, to draw from the furnace very long continuous strands of glass by means of a revolving drum on much the same lines as the Gossler process itself. These continuous filaments, a hundred of which may be woven into a strand little thicker than a human hair, have a smooth, silky finish; hence the product is known as glass "silk." Very fine glass fibres have extremely high tensile strengths, approximating to that of steel, especially when made of the optical quality glass which must be used to ensure continuous fibre production. In fact, fibres have been produced with one quarter of the theoretical maximum strength. By the processes described they can be produced commercially in sizes down to 0.0002in. in diameter, for subsequent working up into the various forms suitable for electrical insulation.

Besides the properties which have already brought fibre glass to the fore as a thermal insulating material—that is, chemical inertness, high strength, non-inflammability, resistance to bacteria, moulds, and vermin, and ability to withstand severe vibration—glass has a number of properties which make it attractive for electrical insulation. It is an excellent dielectric with a breakdown strength much higher than is ever likely to be required in practice; it is comparatively light in weight in relation to its electrical resistance, which means a considerable reduction in the finished article; and, in the form in which it is used for covering electrical apparatus, it has a heat conductivity appreciably greater than that of the more conventional electrical insulators, asbestos, silk, and cotton. The latter statement may at first sight appear not to agree with the use of glass for heat insulation, but the paradox disappears when one considers the method of application in the two cases. For heat insulation the glass fibres form a loosely intertwined mat, entangling innumerable tiny air pockets, which oppose the passage of heat. The closely woven tape or ribbon employed in electrical insulation, on the other hand, holds comparatively few air pockets. Full advantage can therefore be taken of the heat conductivity of the glass itself.

An important advantage of glass insulation is that neither its insulating power nor its mechanical strength is seriously reduced either by comparatively high temperatures or by high humidity. Thus it is possible to subject this material to severe conditions and to employ electrical apparatus under conditions which would mean failure if the more conventional insulating materials were used. Glass insulation can be raised to a temperature of 200 deg. Cent. without appreciably reducing its tensile strength. Cotton, silk, and asbestos would be seriously affected at this temperature. Under experimental conditions in the laboratory, coils wound with glass tape have even withstood temperatures as high as 800 deg. Cent., a temperature very much greater than is likely to be encountered in practice, even under the most adverse conditions. Although dampness arising from high humidity of the air reduces the insulation resistance of glass considerably, as it does that of other materials, it is found in practice that electrical apparatus which has been subjected to such conditions is not permanently injured and will again be capable of functioning after drying out.

As showing the reduction in working temperatures under normal working conditions which result from the use of glass, it is interesting to note that a motor for which cotton insulation was used had a designed rise of temperature of 78 deg. Cent., whereas with fibre glass the rise was only 52 deg. Cent. At the same time the reduction in weight effected was 30 per cent. Such a saving in weight becomes of considerable importance when motors and other equipment are used for vehicular transport. Glass insulation is being increasingly employed for this type of work, both in new designs and for modification of existing motors. The neatness of the covering possible with glass fibre insulation enables the size of the finished apparatus to be appreciably reduced. In the case of covered wire, this may greatly ease fitting work, especially where leads have to be brought through a restricted space. Although in its infancy, glass fibre is already available in a considerable variety of forms. Tape is produced in the usual standard widths, down to a minimum of 0.002in. Numerous standard diameters of braided sleeving are also made. Both round and square wire covered with glass yarn is also on the market, the former in all sizes, and the latter in wall thicknesses corresponding with various standard sizes.

A number of problems remain to be solved before glass insulation can be used as widely as its outstanding electrical and mechanical properties promise. Its acceptance is unfortunately being partly restricted at the present time by the lack of an impregnating material whose electrical properties are comparable with those of glass itself. The impregnating materials at present available limit the temperature at which glass electrical insulation can be used satisfactorily to about 100 deg. Cent., whereas the dielectric breakdown strength and insulation resistance of the glass itself would under operating conditions be adequate at more than double that figure. There is little doubt that the efforts which are being devoted to finding a suitable impregnating material will before long have a satisfactory outcome.

Another important point concerns the smoothness of the fibre and of the woven material which results in a tendency for it to slip during winding. A number of suggested solutions to this problem are being investigated, including the production of a closer cloth with the same thickness, and

coating the fibre with some suitable material.

For one motor in which glass fibre was used for the insulation it is claimed that no amount of overloading will affect the motor, so long as the rotor continues to turn. Under test it carried a 100 per cent. overload for 6 hours without damage. Even with the rotor locked for 5 minutes the motor, it is said, withstood a 200 deg. Cent. temperature rise without harm. A continuous working temperature of 90 deg. Cent. does not harm the motor. It thus gives good service where high temperatures cannot be avoided, as for example, for mixing molten metals.

In another test, the motor was run for 6 hours with one phase opened. It continued to run as a single phase machine, the only result being an unusually big temperature rise, which fell to normal when the missing phase circuit was restored. An ordinary machine would almost certainly have suffered so much damage as to need rewinding under these conditions. Soaking in water failed to harm the windings. While they were hot, the whole motor was immersed in water, and removed, and the full voltage was then applied with the rotor locked. Three minutes after this drastic treatment the winding had dried out and full insulation value had been restored. Splashes with liquid or with most acids, or accidental hosing, do not put the motor permanently out of action. After drying out normal operation is restored. This type of motor is therefore becoming popular in chemical works where wetting of this nature is liable to occur.

Obituary

PROFESSOR A. E. H. LOVE

THE death of Professor Augustus Ernest Hough Love occurred at Oxford on June 5th. He was born in the year 1863, and after education at Wolverhampton, he proceeded to Cambridge, where he entered St. John's College. He graduated in 1884 and in the following year he was placed in the first class in Part II of the Mathematical Tripos and received a Smith's Prize. Subsequently he was elected a fellow of his College and turned his attention to applied mathematics. His contributions to that subject earned him a fellowship of the Royal Society in 1894, and four years later he was appointed Sedleian Professor of Natural Philosophy in the University of Oxford. From 1895 to 1910 he was secretary of the London Mathematical Society, and in 1912 was elected to its presidency. Professor Love's contributions to science were made in the fields of terrestrial physics, theoretical mechanics, the theory of elasticity, and other kindred subjects. His principal published work was his "Treatise on Elasticity," a volume which, in its enlarged edition, is one of the principal contributions to the literature of this subject.

WILLIAM ALBERT WHITE

THOSE of our readers who are associated with marine engineering will regret to learn of the death of Mr. W. A. White, the chairman and managing director of White's Marine Engineering Company, Ltd., of Hebburn-on-Tyne, and the inventor of the White "Economy" engine, and the White oil-burning system. Mr. White, whose death took place in Newcastle-upon-Tyne on Sunday last, June 9th, was sixty-one years of age. He was born in Sunderland and served his engineering apprenticeship with the Middle Docks and Engineering Company, Ltd., of South Shields. He was at sea for many years and crossed to Canada in the first turbine-driven steamer to be built for service on the Canadian Lakes. Subsequently, he went to New York and supervised the first Parsons marine steam turbines to be built in America. While in the United States Mr. White founded in 1910 the Washington Engine Works, which he carried on until the last war, during which he disposed of his interests and returned to England. On his return he was made a member of the Petroleum Board under Lord Cadman, and as consulting engineer to the British Mexican Petroleum Company, Ltd., was responsible for the erection of that company's oil fuel station in Great Britain. His interest in the burning of oil under boilers was aroused, and gave rise to the White oil-burning system which was first manufactured at South Shields, until 1920, when he founded White's Oil Burning Company, Ltd., in 1922, which later became White's Marine Engineering Company, Ltd., when works at Hebburn-on-Tyne were started. It will be recalled that the White patented combination high-speed, high-pressure reciprocating engine, exhausting into a low-pressure turbine geared to the same propeller shaft, was in 1934 installed in the cargo steamer "Adderstone," and gave excellent results, paving the way for further installations in cargo ships and small naval vessels. Mr. White was chairman of the White Shipping Company, Ltd., and was also director of several other companies. He was a member of the Institute of Marine Engineers, and an associate member of the Institution of Mechanical Engineers and the Institution of Naval Architects.

SIR THOMAS HUDSON BEARE

WIDESPREAD regret will be felt by our readers on learning of the death at Edinburgh on Monday, June 10th, of Sir Thomas Hudson Beare, LL.D., M. Inst. C.E., F.R.S.E., D.L., Regius Professor of Engineering in the University of Edinburgh and Dean of the Faculty of Science there since 1914.

Sir Thomas was born in Adelaide, South Australia, on June 30th, 1859, and was the youngest son of the late Mr. Thomas Hudson Beare, of Netley, South Australia. He studied at Prince Alfred College and the University of Adelaide, and having, in 1880, been awarded the Fife (Australia) Scholarship, he proceeded to University College, London. His association with Edinburgh began in 1887, when, at the early age of twenty-nine, he became Professor of Engineering in Heriot-Watt College. Two years later he succeeded Professor Kennedy in the Chair of Mechanical Engineering in University College, London. In London his teaching attracted many students, who, like those who studied under him later, had a warm personal regard for him. In 1901 he returned to Edinburgh as Professor of Engineering in the University, succeeding the late Professor Armstrong. His teaching and administrative record was one of steady and successful work, and in 1914 he became Dean of the Faculty of Science. Writing in the *Scotsman* in appreciation of Sir Thomas's work, Sir Thomas Holland, the Principal and Vice-Chancellor of Edinburgh University, says: "For thirty-nine years as Regius Professor of Engineering he maintained the technical standard of his work as teacher in one of the widest and most rapidly developing of sciences. And during that time, as the department grew, he planned and equipped the Sanderson Engineering Laboratory at West Mains, making it one of the most up-to-date university departments in Great Britain. But during the same time, as Convener of the University Works Committee, the main burden of planning and building the other new scientific institutions in that colony fell on Hudson Beare's shoulders, as well as the control of the dull but necessary multifarious duties of repairs, reforms, and extensions of the old buildings. For this work he had the perpetual admiration of his colleagues on the University Court for thirty-one years."

He was knighted in 1926 and four years ago the Senatus departed from its usual custom of honouring one of its own body whilst still in office, and conferred upon him the LL.D. of the University. He found time for other work outside the University, and was Chairman of the Governors of the Royal (Dick) Veterinary College, Deputy Chairman of the Agricultural College, Governor of the Heriot-Watt College, and member of the Safety in Mines Research Board. He also took a keen interest in the Miners' Welfare Committee. Few men, it may be truly said, served public interests so unselfishly and efficiently, and up to the last his energy never seemed to tire.

Sixty Years Ago

THE PROGRESS OF ELECTRICITY

"VESTED interest is like an old citadel attacked by new-fashioned guns. Sooner or later the guns prove too powerful to be resisted, and so it is with new advances in science. . . . The coming weapon to cause change seems to be electricity." So we wrote in our issue of June 11th, 1880. It had recently been said, we continued, that in the eight years from 1790 to 1798 as much real progress had been made with the root and stem of electricity as had been made in all the subsequent years. At that period, we said, the means of production of electricity and the effect of electro-chemical decomposition were known and applied, while in the last-named year a line 26 miles long was worked by frictional electricity. [We gave no particulars of this line, but presumably it was a telegraph line.] Nevertheless, we continued, the statement was too sweeping, for it could be shown that giant strides had been made since the end of the eighteenth century. Signs of progress were evident not only in what had been done, but in what had recently been indicated as soon likely to be accomplished. Under the second-named heading we instanced the work being carried out by Dr. Siemens and his brother on electro-metallurgy, electro-horticulture, and electro-propulsion, and mentioned that Edison in America was also reported to be investigating electric propulsion on railways. Dealing with Dr. Siemens' electro-metallurgical experiments, we gave some particulars of the electric crucible furnace, which he was employing in his experiments on the melting of iron and steel by electricity. The numerical data mentioned in connection with the dynamo supplying the current are interesting, if only for the nomenclature attached to them. The dynamo, we said, consumed 4·25 horse-power or 3·17 ergtens per second. It could send a current of 40·5 webers through 1 ohm. The same current would flow if that resistance were replaced by an arc with a difference of potential of 37·8 volts between the electrodes. According to Dr. Siemens, so we said, the energy developed in the arc, namely, $1378 \cdot 1 \times 10^{10}$ ergo per 15 minutes, was equal to $32 \cdot 8 \div 10$ gram water degree units of heat. On this basis we calculated that 1 ton of coal would be required to fuse 1 ton of steel in the electric furnace. . . . Elsewhere in the same issue we find a paragraph dealing with Edison's experiments on electric traction for railways. At Menlo Park it was reported he had constructed a railway on which he was running an electric locomotive hauling an open car. Current was supplied to the track by two copper wires, one connected to each rail. Edison claimed that he realised at the locomotive 70 per cent. of the power applied to the generator. The representative of an American contemporary, who had attended a trial of the railway, reported that with about fourteen others he had travelled on it at a speed of from 25 to 30 miles an hour.

Limitation of Supplies

Two Orders have been issued by the Board of Trade, and one by the Non-Ferrous Metals Control, which will have the effect of limiting supplies of machinery and certain commodities in order that more materials shall be devoted to the war effort, as well as to release labour for the same purpose (see also Markets, Notes and News). The first, issued by the Board of Trade, is known as the Limitation of Supplies (Miscellaneous) Order, 1940, restricting the supply to retailers of a long list of articles in common use. No foodstuffs are included, but many household goods. It is estimated that in 1939 the retail sales of all the goods now to be controlled amounted to about £250 million, whereas those brought under control by the similar Order made in April last were valued at about £100 million. Large numbers of persons (skilled and unskilled) will be required in the near future for war purposes. Powers have been taken by the Government for diverting labour, raw materials, and productive capacity from civilian to Service production. If this diversion is not to be made at the expense of export trade it must be accompanied by an equivalent reduction of civilian consumption. The purpose of the new Order, therefore, is to release manufacturing capacity for vital purposes without, at the same time, causing curtailment in production for export, the maintenance of which is so essential a part of the war effort. Supplies to retailers of all the commodities now brought under control are to be restricted to two-thirds of the supplies made to them during the six months ended November 30th, 1939. Supplies are to be calculated by value and not by quantity. Supplies required by Government Departments, either directly or through contractors, may be made without restriction. Neither will exports of the controlled goods be restricted. The control of home consumption is exercised through the manufacturer and the wholesaler, both of whom are required to apply to the Board of Trade for registration before June 20th. Provision is made for exemption from the necessity to make any application for registration and from the other requirements of the Order of every manufacturer (who is not also a wholesaler), whose trade within each separate class of controlled goods has not amounted to more than £250 in any one of the past twelve months, or will not in any one of the coming six months amount to more than £167 (roughly two-thirds of £250). All persons required to register under the new Limitation of Supplies Order and all those who may be in doubt as to their obligations under the Order are asked to consult their trade organisations. It will be impossible for the Board of Trade to reply without considerable delay to letters from all individuals affected by these Orders—the number may well be over 100,000—but the Department will give urgent attention to inquiries received from export groups, trade associations, and Chambers of Commerce on behalf of their members. Persons requiring further information about the Orders should direct their inquiries to these organisations. Explanatory memoranda will be on sale at the Stationery Office and obtainable through all booksellers. An Order came into force on Monday, June 10th, bringing all goods under the operation of the import licensing system with the exception only of certain live animals. It will remain possible to import certain essential materials under Open General Licence, full details of which are now available in a Notice to Importers (No. 76), which is now available.

Intermittent Pressure Pumps

IT is a well-known fact that under favourable circumstances the ordinary plunger pump can develop a volumetric efficiency exceeding 100 per cent. The phenomenon is associated with the cyclic variation in the velocity of the piston. During the first part of the delivery stroke the velocity of the piston continually increases, forcing the column of liquid in the discharge pipe to move with increasing speed. But after passing the half-stroke point the piston speed begins to fall. If, however, the delivery pipe has a considerable length the column of water therein

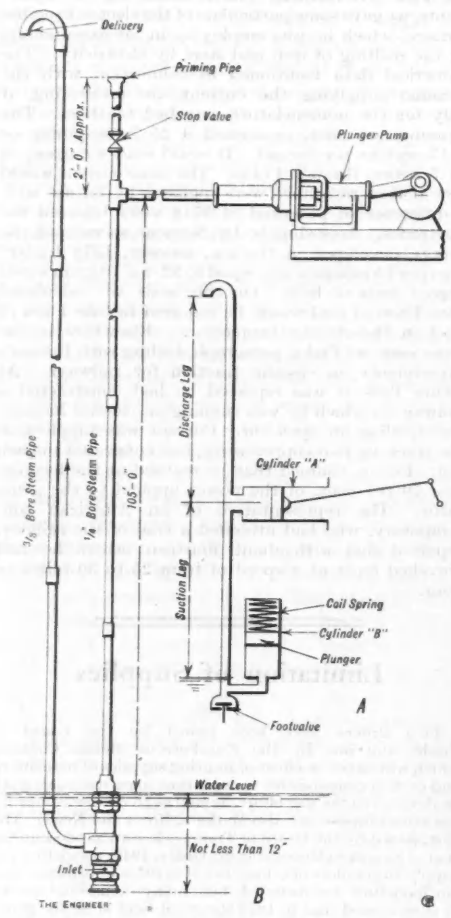


FIG. 1—EXPLANATORY DIAGRAM AND DEEP LIFT PUMPING INSTALLATION

will tend to continue to move at a speed corresponding to the fastest motion of the piston, with the result that the pressure in front of the piston is released. The fall in pressure within the cylinder may become so pronounced that the suction valve opens despite the fact that the piston has still some portion of its inward stroke to complete. A condition then occurs in which the suction and delivery valves are both open and liquid is passing straight through the cylinder, drawn forward entirely by the inertia of the moving column of liquid in the delivery pipe. This condition may persist even during the early part of the suction stroke and if it continues during a sufficiently long interval it will result in the delivery of the pump exceeding the volume swept by the piston.

In the products of Fluid Transfer, Ltd., of 121, Victoria Street, London, S.W.1, this action is encouraged to occur by the provision of a bye-pass non-return valve between the suction and delivery branches. But further use is made of the inertia of the column of liquid in the delivery branch in plants made by the firm under patents held by it in conjunction with R. Harland Dickinson. By a suitable disposition of the units of the pumping system it is possible to lift and deliver water by the use of a pump situated at a level more than the barometric height above suction level. In obtaining this result

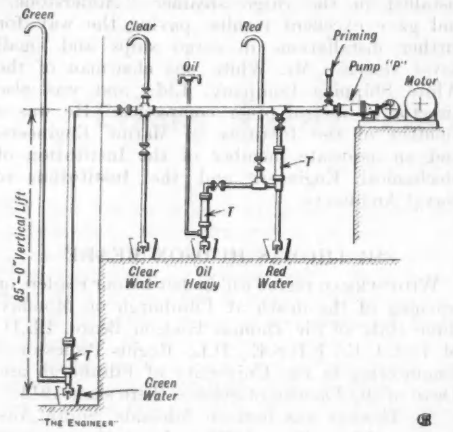


FIG. 2—PUMPING SEVERAL LIQUIDS WITH A SINGLE PLUNGER

use is made of the inertia of the liquid in the discharge pipe to impose a fluctuating or intermittent pressure upon the contents of the suction pipe. The effects thus produced will be explained by reference to the diagram, Fig. 1A, which, being intended to elucidate the principle, does not represent the lay-out of an actual installation.

A vertical pipe has a foot-valve at its lower end

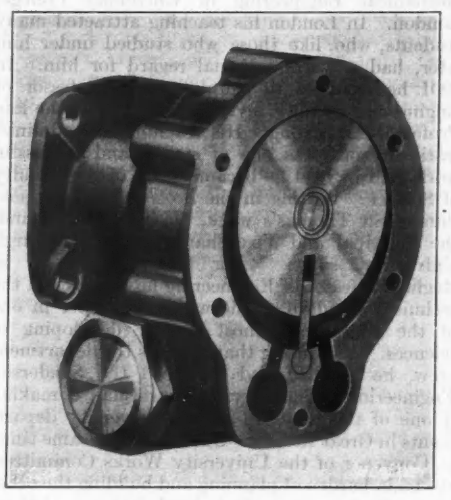


FIG. 3—SINGLE ROTOR PUMP

which is immersed in the suction reservoir. At any convenient point in its length there is in connection with the pipe a cylinder "A" within which there works a piston driven by a crank. The cylinder is not provided with any valves. At the lower end of the pipe there is connected another cylinder "B" containing a piston which is pressed downwards into contact with the liquid by a strong spring. If now it be supposed that the piston "A" is forced inwards by the rotation of the crank it will accelerate the column of liquid in that portion of the pipe marked on the diagram "discharge leg." But the pressure exerted to bring about that acceleration will equally be exerted upon the liquid in the "suction leg" and in the cylinder "B." Consequently the piston within cylinder "B" will be forced back against its spring. In the latter half of its forward stroke the speed of the piston in cylinder "A" is reduced, the inertia of the liquid in the discharge leg carries it forward, and the pressure in cylinder "A" falls. By the time the suction stroke is begun the pressure in cylinder "A" may be considerably below that existing even under the static condition. Consequently the piston in cylinder "B" is forced forward by its spring and sets in motion the whole column of liquid in the suction leg. In fact the whole column of liquid in the whole length of the vertical pipe is set in motion with the result that the pressure on the footvalve is released and more liquid is drawn in at the bottom.

The principle, therefore, is to apply an intermittent pressure to the contents of the suction pipe, with the result that, on the release of the pressure the contents, as it were, "jump" upwards. It has been found that for all ordinary pipe materials the provision of the second cylinder "B" is quite superfluous, the elasticity of the pipe and presumably also of the liquid itself being quite sufficient to produce the effect. The drawing, Fig. 1B, shows the arrangement of an actual installation operated by a 2½in. bore plunger pump. It will be seen that the pump itself is situated 105ft. above the suction water level. In this case the delivery pipe branches off the vertical "pumping" or "driving" pipe near the bottom, but the rearrangement does

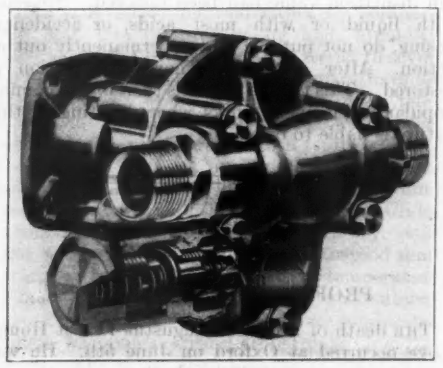


FIG. 4—RELIEF AND BY-PASS VALVES

not affect the principle of operation although it leads to a small increase in efficiency. The upper part of the "driving" pipe is provided with a stop valve and a priming pipe since this pipe must be fully primed before the pumping action can begin. At the bottom there is a plunger which divides it off from the delivery pipe. A "regulator" (not shown) at the top of the "driving" pipe is provided to control the delivery independently of the speed of the pump. In the regulator a cushion of air is entrapped, the volume of which is controllable. The effect of the air cushion is to reduce the pressures created by the motion of the piston and thus, as a consequence, to reduce the delivery. A valve on the "driving" pipe below the air cushion allows the effect of the air cushion to be adjusted and so regulates the delivery.

The diagram, Fig. 2, is also interesting. It represents a small "demonstration" set that has been installed in the London offices of the firm and shows how a single pump can be made to deliver a number of different fluids without intermixture. The "intermittent pressure" provided by the pump "P" is transmitted to a number of suction pipes through spring-loaded plungers "T" or similar devices which, though capable of transmitting the pressure, prevent admixture of the liquids. Each "circuit" is thus made to operate as an independent unit, although all are put in action by a single pump.

The need to economise space forbids us dealing at any length with the many products of the firm and we must content ourselves with a drawing of a twin-rotor airscrew pump and three half-tone engravings together with some characteristic curves. In these smaller machines, which are designed to operate on the principles outlined in foregoing paragraphs, a

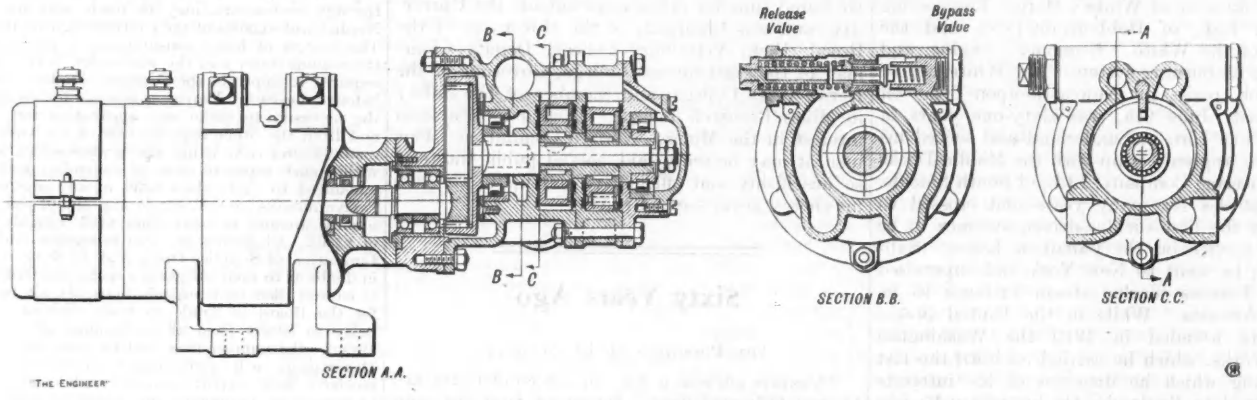


FIG. 5—GEARED DRIVE TWIN ROTOR AIRSCREW PUMP

well-known form of rotary design—Fig. 3—is adopted. Readers of the series of articles in our 1939 volumes on "Rotary Engines and Pumps" will recognise that the design of pump adopted provides a delivery fluctuating between zero and a maximum during each revolution. This characteristic is a necessity if use is to be made of the inertia of the fluid flowing in the delivery pipe.

FIG. 6—SELF-PRIMING FIREFIGHTING PUMP

As shown in Figs. 4 and 5 each pump is provided, in addition to a spring-loaded release valve that protects the mechanism against excess pressures, with a spring-loaded bye-pass valve between the suction and delivery branches. This device permits the moving column of liquid in the delivery pipe to "draw" liquid straight through the pump whenever the "piston" is decelerating. The drawing is self

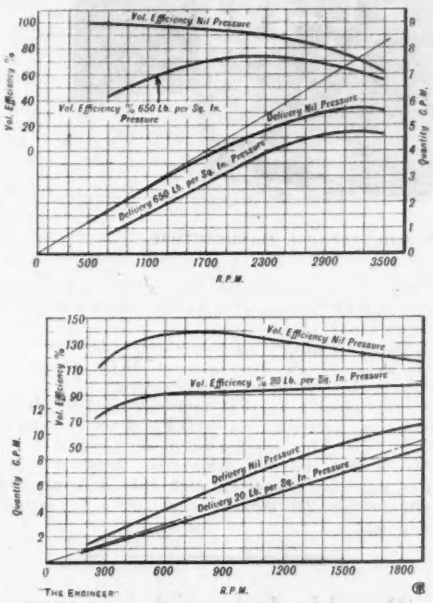

Vol. Efficiency Nil Pressure
Vol. Efficiency % 650 Lb. per Sq. In. Pressure
Delivery Nil Pressure
Delivery 650 Lb. per Sq. In. Pressure
Vol. Efficiency %
Quantity G.P.M.
R.P.M.
Vol. Efficiency Nil Pressure
Vol. Efficiency % 20 Lb. per Sq. In. Pressure
Delivery Nil Pressure
Delivery 20 Lb. per Sq. In. Pressure
"THE ENGINEER"

FIG. 7—CHARACTERISTICS OF TWIN ROTOR AND SINGLE ROTOR PUMPS

explanatory. In connection with the characteristic curves it should be noted that the single-rotor fuel pump has a volumetric efficiency rising as high as 140 per cent. at zero pressure and well maintained above 90 per cent. at 20 lb. per square inch pressure. The little firefighting pump, Fig. 7, weighs 6 lb. and delivers 2 gallons per minute through 30ft. of non-kink hose and a "Duplex" jet.

LOCOMOTIVE AND TENDER CONNECTIONS.—In the ten locomotives which are being built for the service of the Chicago, Burlington and Quincy Railway at West Burlington and the articulated Mallet locomotives being built for the Delaware and Hudson Railway by the American Locomotive Company, use is being made of a new type of joint for the air, oil, water, and steam connections between the locomotives and tenders. It was recently designed by the Barco Manufacturing Company, of Chicago. It has square threads to attach the nuts to the casings, and has more movement between the joints is claimed for the new only one gasket for each joint.

Overhead Bus-Bar System for Machine Shops

FOR electric power distribution in factories containing individually driven machine tools, the English Electric Company, Ltd., of Stafford, has introduced an overhead bus-bar system, now widely adopted by motor-car and aeroplane engine manufacturers. Designed for securing to the roof or roof members of the machine shop, the system consists of metal-clad insulated bus-bars with plug-in points at frequent intervals. The chamber containing the bars is made in 12ft. lengths with connectors and fish-plates so that sections may be connected together to form any length of chamber required. Each length contains six or nine plug-in points into which fuse boxes containing English Electric high rupturing capacity non-deteriorating cartridge fuses can be plugged. Two earth plugs which make contact in advance of the current-carrying plugs allow the fuse to be inserted or withdrawn, with the bus-bars "alive" and with perfect safety to the operator. Typical installations are shown in Figs. 1 and 2.

FIGS. 1 AND 2—OVERHEAD BUSBAR SYSTEM AT A MOTOR CAR WORKS

The system originated in connection with the motor-car industry where frequent rearrangement of the machine tools is necessitated by new production programmes, but it is now realised that the overhead bus-bar system allows a new machine shop distribution system to be designed and installed before the machine tools are in position or even before the exact location has been determined.

Later, when the machine tools are erected, the connections from the overhead bus-bar system to the motor starters can be quickly made.

Sections of the bus-bar chamber are produced in 12ft. lengths and in order to be able to manufacture for stock, only two sizes of bus-bar are supplied, *i.e.*, $\frac{1}{2}$in. bars to carry 200 amperes and $\frac{5}{16}$in. diameter bars to carry 250 amperes. Bus-bar chambers can contain two, three, or four bus-bars for double-pole, triple-pole, and triple-pole and neutral circuits. The number of plug-in points per 12ft. length may be six or nine as required. Twelve types of bus-bar chambers are available as set out in the table below, which also indicates the plug-in fuse boxes available for different sizes of bus-bar chamber:

Bus-bar chamber containing—	Diameter of bus-bars inch.	No. of plug points per 12ft. length.	30-amp. and 60-amp. plug-in fuse boxes available.
Two bus-bars	$\frac{1}{2}$	6	D.P.
	$\frac{1}{2}$	9	
	$\frac{5}{16}$	6	
	$\frac{5}{16}$	9	
Three bus-bars	$\frac{1}{2}$	6	D.P. and T.P.
	$\frac{1}{2}$	9	
	$\frac{5}{16}$	6	
	$\frac{5}{16}$	9	
Four bus-bars	$\frac{1}{2}$	6	D.P., T.P., and T.P. and N.
	$\frac{1}{2}$	9	
	$\frac{5}{16}$	6	
	$\frac{5}{16}$	9	

The main constructional feature of the bus-bar chamber is that the plug-in points for the fuse box are contained in the bus-bar moulded supports fixed to two pressed steel channels, each 12ft. long, arranged in box formation and secured by $\frac{3}{16}$in. tie bolts. Sheet steel cover plates formed slightly convex to prevent the accumulation of water and dirt, cover the top of the chamber, a cork compound packing being employed to make it waterproof. Sheet steel interplates are fixed to the underside of the channels between the mouldings, and these are also provided with a cork compound packing so that when the unit is built up it is completely dust and moisture proof. Throughout their length the bus-bars are insulated with "Paxolin" tubes recessed into the moulded bus-bar supports.

One end of each 12ft. length of bus-bar chamber is provided with fish-plates for coupling to the adjacent length. There are also connectors for the bus-bars. Connecting up of the bus-bars is effected by means of an efficient form of clamping sleeve, secured by four set screws, the heads of which are locked in position by a locking plate. The bracing between the adjacent bus-bar sections is such that the joint as a whole is as strong as the remainder of the structure. To prevent accidental contact the current-carrying sockets in the insulating bus-bar supports are deeply recessed. Twin earth sockets in the moulded bus-bar supports are connected to the side channels.

As shown in the table, plug-in fuse boxes are available for 30 and 60 amperes, and for double-pole, triple-pole, and triple-pole and neutral circuits. They accommodate the company's "S" type porcelain fuse fittings to take standard English Electric high rupturing capacity non-deteriorating fuse cartridges from 2 amperes up to the maximum rating of the fittings, these fuses giving visual indication when the fuse has blown without having to remove the handle.

Each plug-in fuse box comprises a dust-tight sheet steel housing with a side-hinged cover secured by a spring clip fastener and containing plugs for connecting in the bus-bar sockets. The two earth plugs engage in advance of the current-carrying plugs. With their ends screwed the earth plugs pass right through the bus-bar chamber and are secured in position by wing nuts. The earth plugs cannot be inadvertently plugged into the "live" sockets. On the underside of the fuse box is a detachable plate which can be drilled for conduit or flexible armoured cable.

Incoming metal-clad adapter boxes (Fig. 3) can be bolted to any two of the tie bolts along the run of the bus-bar chamber. These adapter boxes contain cable sockets and connectors to the bus-bars and are arranged to accommodate cable-sealing boxes for paper-insulated cables approaching the bus-bar chamber either vertically or horizontally in any direction or angle. Alternatively, the adapter boxes can be arranged for conduit entry or for bushed holes.

As the electrically driven machines are almost invariably arranged in lines, it follows that the overhead bus-bar system should be run above and parallel to the lines of machines. Usually it is found that one run of overhead bus-bar chamber will feed two lines of machines. Hence, in the average machine shop, the overhead bus-bar system will consist of a number of parallel runs of overhead bus-bar, the length of each run being approximately the length of the line of the machines to be supplied. In some cases the bus-bars are in the form of a ring main, and in other cases tee-off sections are necessary; but no hard and fast rule can be made and each scheme must be treated individually. In the case of a length of bus-bar chamber arranged at right angles to the main run, the connections between the two sections are usually made by V.I.R. single-core taped and braided cables in flexible metallic tubing, each end of this tubing terminating in an adapter box as described. The number of feed-in points to the bus-bar chamber must be determined in accordance with the maximum number of plug-in points to be used and their loading.

If the runs are long it is usually necessary to feed in the centre and not at one end. Current loading of the bus-bars per foot run will vary with the different types of machines to be supplied. The

loading of a typical machine tool shop of a motor-car engine manufacturer worked out at 0·7 H.P. per foot run on a single line of machines, the horse-power being taken as the name plate rating of the motors used. This is approximately 1 ampere per foot run on a 440-volt, three-phase supply for a single line of machines, and consequently a double line of machines 200ft. long could be supplied from 200-ampere bus-bars, providing the incoming supply be taken to the centre of the run.

If a large number of small motors are to be supplied the bus-bar chamber containing nine points per 12ft. length section will be necessary; but in the case of a shop containing large motors the bus-bar chamber with six points per 12ft. section will usually suffice. When planning the installation it should be borne in mind that it is desirable that a number of plug-in points be left unused in order that additional supplies may be taken from these points as and when required.

Having ascertained the number of lengths of bus-bar chamber required and the number of feed-in points, it is then possible to determine the number of outgoing ways required on the sub-station board. The cables between the sub-station board and the feed-in points of the bus-bar chamber will usually consist of paper-insulated, lead-covered, and armoured cables run along the roof member of the building.

A suitable form of sub-station board is a "combination" fuse switchboard incorporating English Electric high rupturing capacity non-deteriorating cartridge fuses. The advantage of using these fuses on the sub-station board is that graded operation between these fuses and those in the plug-in boxes will be obtained. Hence a fault on the outgoing

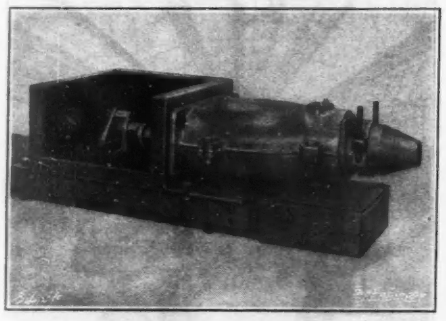


FIG. 3—INCOMING CABLE BOX AND ADAPTOR

side of the plug-in fuse box will always be cleared either by the motor starter or by the fuses in the plug-in box and will not be reflected back to the fuses on the sub-station board. This discrimination is attributable to the fact that the cartridge fuses, although of different ratings, have similar characteristics, and these characteristics are retained throughout the life of the fuse by virtue of their non-deteriorating properties.

Each motor should be protected by a motor starter with overload devices. When selecting the size of fuse cartridge for the plug-in fuse box the type of motor and type of starting must be taken into consideration to ensure that the rating will not cause the fuse to blow as the result of the motor starting currents. If the fuse sizes are properly selected all overloads on the motor will be taken care of by the starter, and in the event of a severe short circuit in the motor or a fault either in the starter or lead-down cables, the fuse in the plug-in box will operate.

Since the most frequent fault on a machine tool is an overload on the motor which will cause the starter to open, this arrangement is ideal for the fuses are unaffected. Hence the operator can close the starter immediately he has removed the cause of the overload and the loss of production time is reduced to a minimum. Another characteristic of these high rupturing capacity non-deteriorating cartridge fuses is that under severe short-circuit conditions the speed of operation is much faster than the speed of operation of the starter, with the result that if a severe electrical fault occurs in the motor or in the connection between the starter and the motor, the fuses will operate before the starter contacts separate, thus preventing burning of the starter contacts or other damage to the starter.

The down leads to the tools may consist of flexible armoured cable or V.I.R. taped and braided cable in screwed conduit. On installations where it is anticipated that machine tools will be frequently rearranged, the flexible down lead has definite advantages, whilst if the installation of machines is expected to remain permanent V.I.R. cables in conduit may be used. A new design of flexible down-lead cable has been developed, consisting of twin or three-core tough rubber-sheathed cable wrapped with oil-resisting tape and finally braided with tinned copper wires. With this type of cable the tinned copper wires on the outside of the cable can be used as an earth conductor. But when near floor level it is necessary to protect this cable mechanically, which may be done by running the cable in conduit from the motor starter to a point about 6ft. above floor level. The portion of the cable inside the conduit has the braiding removed, and the braiding is terminated in a special cone clamp screwed into the top of the conduit.

A similar clamp for the braiding is fitted to the underside of the fuse box. When this form of cable is used the conduit from the starter should be permanently attached to the machine, so that when the machine is moved the conduit moves with it.

Gas-Conditioning Units for Paint and Varnish Manufacture

IT is well known that by the introduction of a protective atmosphere in the furnace and cooling chambers and the provision of special sealing devices preventing both the escape of the gas and inward seepage of the atmospheric oxygen, heat treatment without detriment to—in fact, with improvement of surface finish—is obtained. In this way the high cost of secondary cleaning operations is entirely eliminated, and the consequent economies render the application of this process important in industries manufacturing high-quality products.

But the use of chemical atmospheres of known and controllable composition is applicable to many other branches of industry in addition to that already mentioned. The Incandescent Heat Company, Ltd., of Smethwick, Birmingham, a firm which has specialised for many years on the production of gas-conditioning plants giving atmospheres suitable for bright annealing furnaces, has recently introduced into this country similar plant for use in the paint and varnish industry. The advantages claimed for the plant may be rapidly summarised as follows:—The inert gas produced by the apparatus is a complete substitute for CO_2 at a very small fraction of its cost; the mixing and agitation of synthetic varnishes are accomplished with increased efficiency and superior colour control; the gas supplied to varnish kettles is inert; the gas may be applied to storage tanks with complete prevention of oxidation and skinning; the inert gas is a most reliable means of protection against fire outbreaks; pipe lines are blown out and kept clean; the operating costs, including maintenance, depreciation, and all other items, are low as compared with the savings effected. For instance, liquid or frozen CO_2 costs 20s. to 25s. per 1000 cubic feet, compared with approximately 6d. per 1000 cubic feet for the new gas manufactured from standard town gas.

The base gas is fed into the system and controlled by a Selas electrically driven quality-governing mixer, which maintains with precision correct air-gas ratio proportioning. The gas is then burned in a refractory-lined combustion chamber and passes from this chamber for primary and secondary dehydration. Primary dehydration is of the ordinary surface condenser type and the secondary and final dehydration is by means of the regenerative silica gel system. Finally, any remaining traces of sulphur are removed by the desulphurising unit. From the desulphurising chamber the gas passes into a compressor, and is ready for delivery to the storage tanks, resin kettles, or for other operations about the plant.

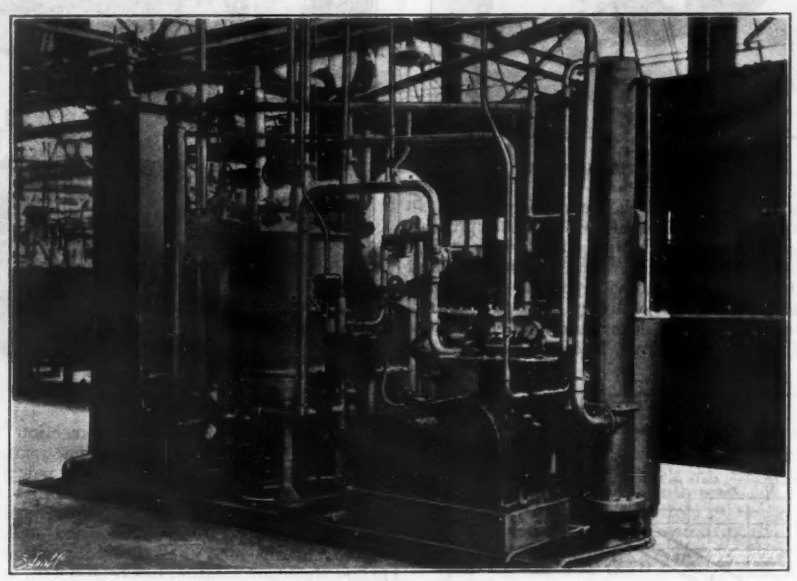
The silica gel unit consists of two adsorbers containing the necessary charge of silica gel complete with activation fan and the necessary connecting pipework and valves. This unit works on the principle of one adsorber drying whilst the other adsorber is being reactivated by the passing of hot air through the silica gel, the change over being necessary every eight hours. The activated air is heated by circulating around the combustion chamber, and the heat of combustion is utilised to the best advantage and efficiency of the plant.

The equipment is completely automatic. The amount of gas is co-ordinated with the demand for inert gas at the point where it is drawn from the line. The high-pressure compressor, which delivers the gas as required, is provided with automatic equipment, to idle when the demand is cut off and to open when the demand rises. Governors are provided to maintain pressure in the storage tank at a constant value and to operate the compressor so as to obtain this result. The equipment is completed by an "Analygraph," which is arranged to take a continuous sample of gas as manufactured and record on a chart any variations in the gas compositions.

The gas produced by the generating unit may be adjusted to have a wide range of different compositions. In the paint and varnish fields its widest application is to supply a strictly neutral inert atmosphere, which will not support combustion and which has no appreciable fuel value, so that it cannot be burned. A typical analysis of this gas is given below:

Substance.	Percentage.
Carbon dioxide	10
Carbon monoxide	1·9
Oxygen	0
Sulphur	0
Oxides of nitrogen (traces)	0
Water vapour	0·1
Nitrogen	88

It will be noted that the gas is substantially carbon dioxide and nitrogen. The water vapour content can be kept down as low as 0·1 per cent. by the use of the silica gel plant, and the temperature of the



GAS-CONDITIONING UNIT FOR PAINT AND VARNISH MANUFACTURE

cooling water on the primary condensers, which varies considerably during summer and winter, has no appreciable effect.

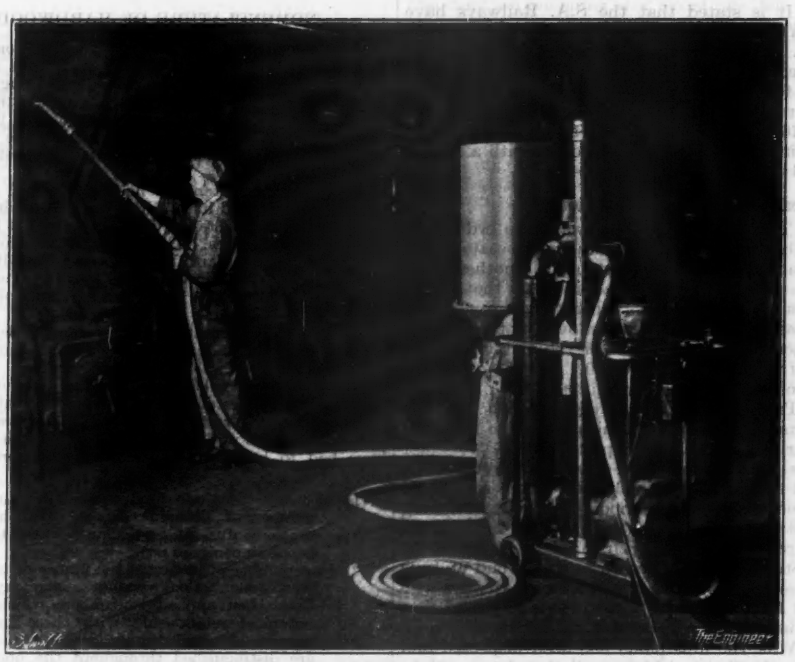
A plant to supply approximately 1250 cubic feet of conditioned gas per hour at 35 lb. pressure is shown in the accompanying engraving.

In this plant a $1\frac{1}{2}$ H.P. motor is used for driving the air-gas mixer and a $\frac{3}{4}$ H.P. motor is required for the fan. The compressor motor absorbs 4 H.P. Between 300 and 400 gallons per hour of cooling water must be passed through the condensers and approximately 250 cubic feet of town's gas is burnt per hour.

Portable Industrial Vacuum Cleaner

PRACTICALLY every industry has its own particular dust problem. In many cases the dust created during the manufacturing stages is of a nature that is detrimental to factory machinery and production, while dust that is of an inflammable character increases the risk of fire and constitutes a source of danger that must be removed in the most efficient and economical manner available. The accompanying engraving shows a portable industrial vacuum cleaner which has recently been put on the market by Davidson and Co., Ltd., of Belfast, and which is claimed to possess many advantages in design and performance over the ordinary type of vacuum cleaner now in use. The equipment has been designed to meet the demand for a really heavy-duty machine. It is fitted with a positive-acting rotary exhauster capable of setting up a very high suction, while the air volume handled remains constant irrespective of the amount of material handled—a distinct advantage not met with in general practice. The filter, we are informed, is of ample size to deal with heavy concentrations

of dust, and is arranged vertically to permit of easy and effective cleaning, which is also assisted by a special arrangement whereby the air flow through the filter can be reversed. The material collected is not stored inside the filter, but in a small hopper beneath it, which can be easily discharged into a



PORTABLE INDUSTRIAL VACUUM CLEANER

sack by merely turning a handle. This arrangement does not limit the capacity of the equipment by the capacity of a receiver or filter, and it can therefore be operated continuously. It is only necessary to replace the full sack with an empty one as the occasion arises. The cleaner can also be used for blowing by means of a change-over valve, and special apparatus is provided for blowing out equipment which cannot be readily cleaned by suction. The standard equipment is complete with cleaning tools ready for service, but additional hose and trailing cable, or special types of motors and cleaning apparatus, can be supplied to meet specific requirements.

Heavy-Duty Slotting Machine

THE accompanying engraving shows a new 26in. stroke heavy-duty slotting machine recently developed by Ormerod Shapers, Ltd., Hebden Bridge. The machine is mounted on a base heavily ribbed to give

HEAVY DUTY SLOTTING MACHINE

great rigidity under all working conditions, and the slide-ways carrying the table are of large area, to take the shock of the cutting tool. The table is traversed either by hand or self-acting power feed, and also has a rapid power traverse through a separate motor, the rapid power traverse being so interconnected with the feed that it operates in the opposite direction. A reverse box is also provided. The machine is driven by a 20 H.P. motor, mounted on the rear of the column, through vee ropes, a friction clutch and a nine-speed gear-box, which is housed inside the body. The gear wheels are of heat-treated nickel-chrome steel, and are mounted on solid multi-splined shafts of large diameter. The final drive to the ram is by double steel gears, and a steel link. The link motion, gear-box, and main bearings are cascade lubricated by means of a pump. The stroke may be varied whilst the machine is in motion or at rest, and a locking device is fitted. The machine occupies a floor space of 13ft. by 9ft., weighs approximately 11 tons, and is capable of dealing with workpieces with diameters up to 7ft. and heights up to 3ft. 6in.

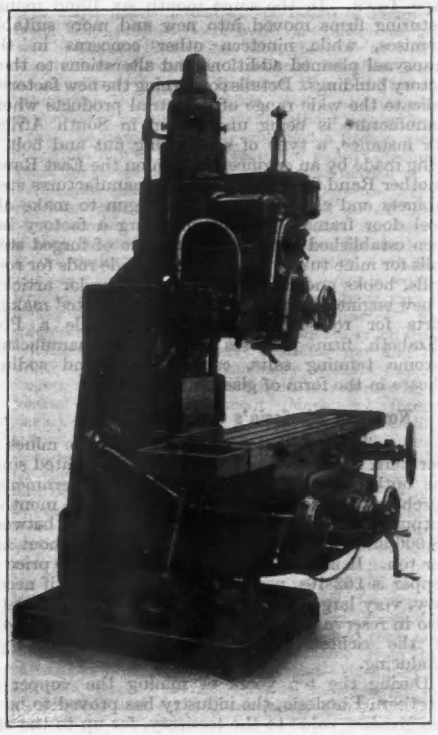
Motor-Driven Vertical Milling Machine

IN an accompanying engraving there is illustrated the No. 46 V knee type vertical milling machine with a capacity of 36in. by 13½in. by 22½in., made by Alfred Herbert, Ltd., of Coventry.

The drive is taken from a vertical flanged motor bolted to the driving box, power being transmitted directly to the spindle by heat-treated spur gears with ground teeth and running in oil. All shafts are mounted in ball and roller bearings. No friction clutches are used in the drive, as the motor is directly controlled by switchgear operation from the front of the machine. Rigidity of the main spindle is assured by mounting it on the well-tried arrangement of precision type ball and roller bearings. The standardised spindle nose has a non-stick taper and standard clutch drive with provision for securing cutters direct to the spindle. A draw bolt and adapter are provided for fitting arbors and cutters with No. 11 Brown and Sharpe taper shanks. The spindle head is balanced, quick vertical adjustment and fine adjustment with micrometer dial being provided. The head is clamped by a convenient lever. Multiple dead stops with fine adjustment are fitted. If desired, automatic feed can be fitted to the spindle head.

All controls are operated from the working position. Starting and stopping of the machine and motor-driven coolant pump (when supplied) is effected by a panel having four push buttons, mounted on the left-hand side of the machine. The stop button operates a plugging relay which stops the spindle instantly. A switch on the right-hand side of the column reverses the spindle. Fast and slow ranges of speed are provided to enable all work within the capacity of the machine to be dealt with at the most appropriate speed. Speed changes are made rapidly. The fast or slow range is selected by the movement of a lever and the speed required is obtained by simply rotating a dial until the speed comes opposite a pointer. Feed changes are equally rapid. Twelve automatic reversible feeds are provided in all three directions of the table. The rate of feed is selected by rotating a dial similar to that for speed changing, and the feed is engaged by conveniently placed levers which are moved in the direction in which it is desired to traverse the table, saddle or knee. Automatic and dead stops are fitted in each direction. The feeds are the same in all directions of the table movement, a great advantage when milling such work as triangular ports in locomotive piston valves, die blocks and similar work. Quick power traverse by independent motor is fitted to the longitudinal motion of the table.

Quick power traverse can be engaged in either direction, without setting any other levers, immediately the feed has been automatically tripped. The lever is always moved in the direction in which it is required to move the table. When the lever is put into the vertical position, the table stops without operating feed levers, as is necessary on machines where a common shaft is used for both feed and power traverse. When traversing the table back to the loading position, after the cut is finished, the spindle can be stopped to avoid marking the work with the cutter. Quick power traverse of the table in directions other than the longitudinal is obtained by using the coarsest feed obtainable. The hand control for the longitudinal movement of the table is at the front of the machine where all other controls are



MOTOR-DRIVEN VERTICAL MILLING MACHINE

centralised. This is a great advantage when die-sinking, as the operator can move the table in all directions without moving from his position.

A circular table of exceptionally strong construction can be supplied. Hand and automatic feeds are provided. The table is 17in. diameter, and is driven from a shaft inside the saddle.

The principal dimensions of the machine are given in the following table :—

Automatic longitudinal feed	36in.
Automatic transverse feed	13½in.
Automatic vertical feed to table ...	16in.
Maximum distance from surface of table to spindle	22½in.
Minimum distance from surface of table to spindle	0in.
Vertical adjustment of spindle head...	6in.
Spindle end, B.S.I. No. 739, nominal size	5 1/8 in.
Centre of spindle to column	16½in.
Working surface of table	58in. × 15in.
Number of spindle speeds	12
Range of spindle speeds, r.p.m.	25–500
Number of feeds	12
Range of feeds, inches per minute ...	¾in. to 40in.
Floor space occupied	9ft. 7in. × 6ft. 4in.
Approximate net weight	6500 lb.

REDUCING OVERSIZED HOLES.—A note in the *Machinist* describes a simple method of reducing oversize holes. Washers of asbestos, at least ¼in. thick, are placed over either end of the oversized hole and clamped securely in position by iron washers held by a bolt passing through the hole. The area round the hole is made red hot and then quenched in water. It is stated that if the hole is ¾in. or less in diameter and 0·003in. oversize the job should be quenched in warm water, but if it is more than 0·003in. oversize ice water should be used in quenching. As the hole is closed by the asbestos washers the quenching water does not enter and its wall remains at red heat for some time. The accelerated cooling of the outer part of the work causes it to shrink and close in the softer metal round the hole.

A NEW ACID-RESISTING CEMENT.—We have received particulars of a new acid-resisting cement which has recently been placed upon the market by J. H. Sankey and Son, Ltd., of Ilford, Essex. The material is supplied in a fine powder, which is simply and rapidly mixed with the acid-resisting solution supplied for the purpose, and the resultant plastic cement applied in the usual way. It adheres strongly to brick, tiles, stone, concrete, iron, &c., as a jointing, pointing, patching or rendering, and sets to a porcelain-like hardness in about twelve hours. The final hard cement is very dense and close in texture and has a high tensile strength, whilst the absorbency is low. It has good water and heatproof properties and is unaffected by temperatures up to about 1200 deg. Cent. It is claimed that it is not disintegrated by and permanently resists all hot and cold acids, with the exception of hydrofluoric.

South African Engineering Notes

(By our South African Correspondent)

CAPE TOWN, May 2nd.

Union Industries Flourishing

UNDER the stimulus of war conditions oversea, South African industries, particularly on the Rand, are flourishing. The latest reports indicate steady expansion in different branches of industry, some of which are new to this country. In March eleven new factories were registered in Johannesburg alone. Two large new concerns were also set up in Cape Town. In the same month six Rand manufacturing firms moved into new and more suitable premises, while nineteen other concerns in the Transvaal planned additions and alterations to their factory buildings. Details concerning the new factories indicate the wide range of industrial products whose manufacture is being undertaken in South Africa. For instance, a type of self-locking nut and bolt is being made by an engineering firm on the East Rand. Another Rand firm which already manufactures steel cabinets and electric stoves has begun to make all-steel door frames. In Johannesburg a factory has been established for the manufacture of forged steel balls for mine tube mills, bolts, and slide rods for rock drills, hooks and drop forgings, and similar articles. A new engineering firm in Durban has started making parts for road-making machinery, while a Port Elizabeth firm proposes shortly to manufacture chrome tanning salts, caustic soda, and sodium silicate in the form of glass.

Northern Rhodesia's Copper Output

The production of copper from the mines in Northern Rhodesia has been greatly stimulated since the outbreak of war by the British Government's purchases. Prior to the war, the total monthly output of the four producing mines was between 18,000 and 20,000 tons, and the price was about £50 per ton. It is now over 32,000 tons and the price of copper is £62 10s. per ton. The mines can, if necessary, very largely increase their outputs and there is also in reserve the N'changa mine, reputed to be one of the richest in the field, which is not yet producing.

During the ten years of mining the copper in Northern Rhodesia, the industry has proved to be of the greatest value to the terriroty, for up to the end of 1939 the total value of the copper produced was over £52,000,000. Before the mines came to production the territory's revenue was very small; for example, in 1903 it was only £646,283, the income tax amounting to only £88,902, whereas the Budget for 1940 shows revenue at £1,900,786 and income tax £1,063,600. The income tax figure shows how the mines have brought general prosperity, and it is interesting to note that in this item the increase from 1933 is over 1100 per cent. Further, the net total of income for companies and persons in 1933–34 was £692,799, whereas in 1938–39 it had reached £5,980,828, yet this territory has a population of only about 12,000 Europeans. The Rhodesian copper industry is not solely devoted to profit-making, for it supported an immediate offer by the Governor of the territory of £200,000 towards Britain's war effort. It rallied to the call to the industry, jettisoned the further profits it would have made with the price of copper soaring in the world's markets, and devoted the whole of its output to the Empire's need at a normal figure. No figures of output are published now.

In addition, Northern Rhodesian mines are now producing about 25,000 tons of chrome ore, between 650 and 700 tons of zinc, 5000 tons of asbestos, and about 60 tons of fused vanadium monthly.

Copper mining has been dormant in Namaqualand for nearly thirty years, although it was the first metal which the Dutch settlers in South Africa discovered. The credit belongs to van der Stel, Governor of the Cape, who headed an expedition in 1685, which found copper at the Koperberg, but, owing to the situation and the cost of transport, it was considered useless to exploit the ore. Almost one hundred years ago Sir Alexander Selkirk attempted to establish the industry there and had some success. Yet later, a company, the Cape Copper Company, was formed, and conducted mining operations which had great success, owing to the richness of the ore. The operations of the company gradually declined, mostly because of increasing depth of the ore and the neglect to keep up to date in regard to mining methods. Now, however, operations have again been started, and with the use of proper methods and machinery and sufficient capital, have been so successful that two mill units have just begun operating on the copper mine at Nababeep, where 750 coloured workers and 250 Europeans are now employed. Copper ingots will be shipped from the property in June. The British Ministry of Supply has offered to take the whole output of the mine during the war period. The flotation plant is already treating ore. Pulverised coal, brought from the Bitterfontein railhead by ten motor buses of 10 tons each, with 5-ton trailers, will be used in the smelting furnaces. The concentrates and oxidised ore will emerge from the reverberatory furnaces as blister copper. This will be shipped as return cargo in the coal buses in ingot form. Water is being pumped along 17,000ft. of piping to the mine from shafts of 600ft. and 300ft. A modern hospital with X-ray equipment is being erected. It is also announced that the O'okiep copper mines are also to be brought into operation.

South African Railway Purchases

It is stated that the S.A. Railways have placed an order in Canada for steel rails to cost about £750,000. They have also recently placed orders in the United Kingdom. The biggest order was worth £10,000 for stocks and switches, placed with a Middlesbrough firm. An order for a 20-ton crane, costing £6000, was placed with a Leeds firm. The Royal Mint, Pretoria, placed an order with a British firm for two furnaces costing £5640.

American Planes for the Union

The South African Airways are ordering a further thirteen Lodestar (Lockheed) 14-seater aeroplanes and two 30-seater machines of another make from the United States, in addition to the sixteen Lodestars already ordered. When they arrive all the Junkers aeroplanes will be taken over by the Defence Department. The total cost of the thirty-one new machines will be about £450,000.

The Lodestars, which are equipped with the same type of Pratt and Whitney engines in use in South African mail planes, have a cruising speed of 235 miles per hour. The cruising speed of the 30-seater machines is 260 miles an hour. Deliveries are expected to start in September and to be completed twelve months later. A report from Johannesburg says that delivery of the first Lockheed passenger plane purchased by the South African Airways in the United States will be taken towards the end of June by representatives of the South African Airways who have left for the United States. It is expected that the manufacturers will be able to deliver a plane a week. After the first plane has been inspected and tested by the South Africans, all the planes will be shipped.

The Union's Export Trade

The effect of the war on the various branches of the Union's harbour activities is illustrated by the dock returns for February. Compared with last year, there were 4900 fewer passengers coming from overseas, a sudden spurt by people anxious to get home soon subsiding. Exports to Britain increased largely. The total cargo shipped in the Union amounted to 301,114 tons, an increase of more than 80,000 tons compared with the corresponding period of last year. The actual number of ships visiting the Union has decreased. This has come about as a result of the prevention of duplicate sailings by competitive lines. Nearly every Union port recorded an increase in oil bunkering, but coal exports and coal bunkered showed a falling-off. At Durban, the chief coal-shipping port, the coal exported fell off by 23,000 tons.

Tunnel Cooling of Fruit

On the recommendation of the technical adviser to the Perishable Products Export Control Board, the introduction of a system of tunnel cooling was approved in 1938, and three precooling chambers at a fruit berth at Table Bay were converted for the purpose of experiment. The work was completed and came into operation in December last, and the new method of precooling was subjected to a practical test during the deciduous fruit season. It was established that under the "tunnel" system, the efficiency of cooling is more than doubled. In particular, the new method has facilitated compliance with the strenuous conditions imposed for the precooling of fruit for the American markets, and has enabled a new technique to be adopted in the carriage of plums overseas, whereby, after thorough precooling, the temperature is raised on board ship to a level which avoids certain storage injuries and enables ripening to proceed. The extension of the "tunnel system" to other sections of the precooling store at Table Bay Harbour is now having attention. The introduction of tunnel cooling resulted from intensive investigation and research work carried out by the technical adviser to the Board, Dr. A. J. M. Smith, and his staff. Dr. Smith was seconded to the Board from the Cambridge Low Temperature Research Station in 1937, and was engaged to the end of September, 1939.

Supplies of Drill Steel

In the opinion of Colonel K. Rood, a recognised authority on the Union's steel position, there is no need to fear a shortage of drill steel for the gold mines, resulting from the invasion of Scandinavia and the possible dislocation of steel exports from Sweden. He points out that for some time before the outbreak of war nearly 70 per cent. of the Reef's requirements of rock drill steel was supplied from the works of the Union Steel Corporation at Vereeniging. A proportion of the balance was imported from Sweden, but Britain and America were also sources of supply. Within the next month or two the Corporation will be able to meet practically the whole of the demand of the Rand for rock drill steel. Stocks of imported drill steel still in merchants' yards in Johannesburg are considered to be sufficient to tide over the period until the extended plant is completed at Vereeniging.

British Standards Institution

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria Street, London, S.W.1. The price of each specification is 2s. 3d. post free, unless otherwise stated.

NOMENCLATURE OF HARDWOODS

(B.S. No. 881).—For some time past the confusion of names given to various timbers has been a serious matter for many people engaged in marketing and purchasing material for the woodworking industries. This confusion had increased considerably of late years with the introduction on the market of many more species of timber as an outcome of the promotion of forest resources of the empire overseas.

The need for a standard nomenclature of species of timber was felt, and in 1935 the British Standards Institution published a Standard Nomenclature of Softwoods comprising 74 species. This has now been followed by the present "Standard" Nomenclature of Hardwoods (B.S. No. 881—1939) in which 240 species are catalogued. The list includes all the hardwoods of actual or potential commercial importance in this country and has been compiled by representatives of government departments and scientific and industrial organisations, thus assuring that its application will be general.

The guiding principle upon which the nomenclature has been based was to establish a single standard name for any one timber, and to restrict that name to one timber only.

In putting this principle into effect two main problems have had to be faced. These may be summarised as follows:—

(1) In many cases one timber has been known by a number of different names. This has led to much confusion, particularly where the timber is one in common use.

(2) In a number of instances the names of well known woods such as oak, walnut, mahogany, or teak, have been applied to timbers which have no botanical relationship with those properly so named. Names coming within this category are distinguished throughout the nomenclature by quotation marks.

Whenever a suitable synonym for a timber with a "borrowed" name could be found in common use this has been adopted as the standard name, but in several instances this could not be done without causing some serious dislocation in the industries concerned. A trade practice which has somewhat complicated the nomenclature is that of adopting a name for a variety of timber produced from a certain mode of conversion or from different parts of the tree having distinctive tones or colours. Besides the standard name and the name of the botanical species, information is given of the sources of supply and a comprehensive list of synonyms as applied to each species, not only at home, but also in the country of origin and elsewhere where reference to timber is of commercial importance. The list as it now stands is the result of considerable research and is likely to prove helpful in identifying timbers, especially when use is made of the index with its complete cross references. It is confidently hoped that the general adoption of a nationally agreed standard nomenclature will result in introducing uniformity and simplicity in place of the chaotic conditions which have hitherto existed.

Copies of this new British Standard Nomenclature (B.S. No. 881—1939) may be had from the British Standards Institution, 28, Victoria Street, London, S.W.1. Price 3s. 6d. each (3s. 9d. post free).

DIRECT READING HARDNESS TESTING (ROCKWELL PRINCIPLE)

(B.S. No. 891—1940).—Hardness testing forms a convenient means of controlling heat treatment, case hardening or similar surface treatment of metals and there has been increasing demand for a direct reading test (Rockwell type) which enables rapid routine tests to be made. The need for a standard for such a test has become more and more apparent, and in response to representations from a wide field of engineering the British Standards Institution has prepared and issued the above standard. The standard forms an addition to British Standards on Hardness Testing, which have already been published, namely, B.S. 240, Brinell Test, B.S. 427, Diamond Pyramid Test and B.S. 860, Approximate Comparison of Hardness Scales. In the new standard for the Rockwell test it is explained that in addition to standardising the manner in which the test is made it has been necessary to include requirements relating to the machine itself as the accuracy of the test is largely dependent upon the accuracy of the machine. The standard only includes 3 scales, A, B and C, and the ranges of materials with which these scales may be put are indicated in an appendix, in which there is also a note about scales D to H and the uses to which they are put. A simple means of checking the accuracy of the machine by means of a calibrated steel block is also described.

SHIPS' CABLES

(B.S. 883.)—For some time past there has been a need for a standard specification for cables for use on board ship, particularly since rubber and paper cables for land use are now dealt with in separate specifications. Those who have studied the recently issued third edition of the I.E.E. Regulations for the Electrical Equipment of Ships will have seen a reference to B.S. 883. At the time of the publication of the I.E.E. Regulations B.S. 883 was not actually available, but it has now been published. The specification consists of four sections and two appendices, covering general; vulcanised rubber insulated cables, flexible cables and flexible cords; impregnated paper insulated and varnished cambric insulated cables; tests; Appendix A, identification of cores; Appendix B, spark testing of rubber-insulated cables.

Copies of this new British Standard may be had from the British Standards Institution, 28, Victoria Street, London, S.W.1, price 3s. 6d. (3s. 10d. post free).

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.r. Export quantities are f.o.b. steamer.

The Pig Iron Market

In the pig iron market efforts are being concentrated upon meeting the demand from firms engaged upon making munitions. Applications for licences are being carefully scrutinised, and although there is no rationing system in force, precedence is given to the requirements of the munitions makers over other needs. For some time past it has been almost impossible to obtain any pig iron for ordinary commercial purposes except in the case of high-phosphoric qualities, the production of which, however, has declined recently. The speeding up of production at the steel works has led to an expansion in the demand for basic iron, and although considerable imports have arrived of late the home output is being pressed to a greater extent. Large quantities are passing into consumption. Fortunately, raw materials generally are in good supply and coke, in particular, seems to be plentiful. Lately the deliveries of scrap have shown a considerable improvement, and the additional home collection has been supplemented by imports. For the time being the situation seems comfortable; but the steel works, which are expanding production to an unexpected degree, are somewhat anxious regarding the future. The demand for foundry iron is increasing, although the light castings industry, which is the largest consumer of high-phosphoric iron, is by no means working at capacity. More foundries, however, have been put on to Government work in this section. Any reduction in the make of this iron has been due to the changing over of furnaces from foundry to basic iron. For the time being supplies are sufficient to meet the requirements of the light castings makers; but any considerable expansion of the movement to include this industry in the national effort would probably reduce the present stocks and might call for an increased production. The consumers of low-phosphoric pig iron are finding the situation somewhat stringent, and it is difficult to obtain this quality except for munitions purposes. The demand has been rising for some time, and although efforts have been made to increase outputs they remain below consumption. Business in hematite iron has been active and the call from the steel works in the Midlands and Sheffield has been exceedingly heavy. Consumption is expanding to an extent beyond the current production, and it is probable that an attempt will be made to meet the situation by increasing the output. Some of the makers still have small stocks which have helped to ease the position, but these are being rapidly depleted.

The Midlands and South Wales

The recent war developments have had a considerable influence upon the business transacted in the Midland iron and steel trades. Most of these establishments are now working seven days a week and twenty-four hours a day, and even the small amount of commercial business which was squeezed in under the conditions previously ruling appears to have been put on one side. The whole industry is concentrating upon production for armaments. Efforts are also being made to supply at least a certain proportion of the output to industries making articles for export. The heavy steel works before the present drive were operating at as near to capacity as possible, but as a result of the intensive effort output has again been stretched to a certain extent, to which, of course, the cancellation of holidays and the full-time working has contributed. The quantities of joists and sections passing into consumption are greater than at any period in the history of the trade, and even larger tonnages would be readily consumed if available. The constructional engineers are fully occupied and their demands are exceedingly heavy, whilst there is a particularly important call for plates of the heavy and medium sizes. The tank makers are busy and considerable quantities are being used by wagon builders. Both of these industries are operating at top pressure. The boilermakers and locomotive builders also have as much work in hand as they can hope to execute for a long time to come. The re-rolling industry in the Midlands for some weeks has been receiving good supplies of billets, but naturally there is some anxiety as to the future owing to the seizure of the Luxemburg and Belgian works by the Germans. So far, as a result of the considerable imports of semis in the latter part of April and the beginning of May, there has been no interruption in production, and it is hoped that the fresh arrangements being made for supplies from other sources will avoid difficulties. The production of small sections, small bars, and strip is on a heavy scale, and everything turned out passes immediately into consumption. In South Wales the steel works are operating to the fullest possible extent, but the output is scarcely sufficient to meet the demand. The tin-plate works have a large reserve of orders and are working at as near capacity as their supplies of tin-plate bars will permit. Lately the export demand has receded somewhat, but the home trade requirements are expanding.

Scotland and the North

The iron and steel industries in Scotland are being speeded up to obtain the maximum possible production. Seven days a week is now the rule at the steel works and efforts are being made to maintain output at the present rate for some time to come. Of late, raw materials have been adequate, but the new drive will absorb large quantities and intense efforts are being made to increase the flow of scrap from home sources, and it is understood that considerable imports are being arranged. Whilst so much steel is required for armaments practically no commercial business can be undertaken, and export orders have to take a secondary place. All the consuming works in the country appear to be engaged upon war work and are only accepting orders of national importance. The heavy steel works in Scotland are producing at a record rate, but consumers' requirements of steel are also rapidly expanding. The re-rollers are engaged to the full extent of their supplies of semis and their outputs are immediately taken up. There is a strong demand for small bars and small sections, and the works have contracts in hand sufficient to keep them employed for a long period. The quotation for small bars, untested, is £14 d/d provinces, and £13 9s. f.o.b., although few of the works are able to accept export orders for the time being. The demand for steel from the shipyards has reached large proportions and there is a particularly strong call for plates of all sizes and thicknesses. The increase in the scope of the war effort has involved the malleable ironmakers in Scotland and there is an insistent demand for good quality wrought iron bars, particularly for the small sizes, and the request for malleable iron fittings from the Service Departments has reached abnormal proportions. The Lancashire steel industry is bending all its energies towards increasing production, and in many establishments record outputs have been attained. Great pressure is being applied by the structural engineers to obtain deliveries of joists and sections, and in spite of their endeavours there is a tendency for the steel works to fall behind with deliveries. The locomotive builders and tank makers are also extremely busy and are taking up large quantities of plates. The collieries are large users of steel and there is a continuous active demand for roofing bars and arches. Lately there has been a noticeable expansion in the requirements of alloy and special steels for the engineering industries.

Copper and Tin

The most interesting development in the world copper market of late has been the purchase of considerable quantities of copper in the United States by the Allied Purchasing Commission. According to report, inquiries for tonnages between 25,000 and 30,000 tons have been circulated, and at least 10,000 tons to 12,000 tons have been bought. In spite of these large transactions, however, the tone of the market is uneasy owing principally to the European war situation. It is understood that considerable shipments which were to have been made shortly to the latter country have been cancelled and that practically all business with Italian buyers has come to an end for the time being. Japan has also been in the market and has bought a few thousand tons, but other neutral buying has been poor, the countries chiefly interested being Sweden, Switzerland, and India. The export price has been raised from 11·37½c. to 11·45c., and there is an impression that further advances will be made as the United States Government is expected to enter the market as a big buyer on account of its munitions programme. Stimulated probably by these purchases by the Allied Governments, there has been some improvement in the demand from American consumers. Consumption of copper in this country is assuming large proportions as a result of the new munitions drive, but so far consumers engaged in Government work have been able to obtain the metal they want. That a close watch is being kept upon the consumption, however, is shown by the Order appearing elsewhere on this page limiting the uses to which the metal may be put.... Whilst easier conditions have ruled in the tin market the price is regarded by conservative market opinion as being at a dangerously high level. American interests have bought considerable tonnages and are apparently endeavouring to accumulate large stocks. Buying has been principally directed to prompt tin and tin afloat, obviously because consumers fear that supplies may be interrupted. Reports that the American Government intends to accumulate important war stocks have caused dealers to take the view that the latest increase in the quota will prove insufficient and that the International Tin Committee should remove all restrictions likely to affect production.

Lead and Spelter

The situation in the lead market does not change and the war developments of the past month have had less influence upon this than upon other non-ferrous metal markets. So far as consumers in this country are concerned, supplies are reaching them with satisfactory regularity. The possibility of France requiring fresh sources of supply as a result of the loss of Belgian works is apparent, but it seems evident that this can be made good by purchases of Mexican lead. The loss of markets which have been overrun by the Germans must have greatly limited the Mexican producers' opportunities of selling in Europe, and they will probably be glad to find a substantial buyer in France. It must not be forgotten that in all countries affected by the war there has been a restriction of building activity which has been reflected in a smaller demand for lead for commercial purposes. American statistics give the stocks of refined lead at the end of April as 63,463 short tons. The domestic demand in the United States is steady, and it is noticeable that the producers have retained their price unaltered for some weeks. . . . In the United States the tone of the spelter market is firm, largely as a result of reported heavy purchases by the Allies. Some neutrals have also bought fair amounts and India is stated to be inquiring for good tonnages. The domestic demand in America is strong, and it is expected that the United States Government will require considerable quantities for its rearmament programme. The quotation has risen to 6·25c. East St. Louis, both for home and export. In Great Britain supplies seem ample to meet the needs of firms engaged upon war work. There have been instances, however, in which firms who have asked for G.O.B. grades have been obliged to take metal of higher quality. This would seem to indicate that the stocks of Belgian and other G.O.B. metal in this country have been depleted. Beyond the fact that consumers have had to pay rather more for their spelter this development has had no influence upon the position.

Restriction of Machinery Supplies

Under the Machinery and Plant (Control) Order, 1940, the acquisition and disposal of machinery and plant of the classes specified in the list below is prohibited except under licence issued by the Board of Trade. All persons who propose to acquire machinery or plant of any of the specified classes must therefore first obtain a supply licence from the Industrial Supplies Department (Machinery Licences Division), Board of Trade, 25, Southampton Buildings, London, W.C.2, and no person may dispose of machinery or plant without first ascertaining that the user has already obtained a licence for the supply from him of that machinery or plant. Machinery or plant for direct delivery to an overseas market or to a Government-controlled establishment is, however, exempt from these requirements. There is also an exemption for replacement parts. Machinery users are warned that they should not enter into contracts for machinery or plant without first obtaining a licence. Similarly, machinery manufacturers should not commence work on orders for machinery or plant until they know that the user has obtained the necessary supply licence. Each supply licence has attached to it a certificate which should be obtained by the machinery manufacturer and held carefully by him until the machinery or plant has been delivered, when the certificate should be returned to the Industrial Supplies Department (Machinery Licences Division), Board of Trade, 25, Southampton Buildings, Chancery Lane, London, W.C.2. The licence should also be returned to that Department by the licence holder when the machinery or plant has been delivered. It should be noted that the supply of machinery or plant of the classes specified under contracts made prior to the date of the Order is not exempted from the licensing regulations, and persons who have already placed orders for such supplies should make their applications for licences without delay. Applications for licences should be addressed to the Industrial Supplies Department (Machinery Licences Division), Board of Trade, 25, Southampton Buildings, London, W.C.2, and they must be made on forms which are obtainable from that Department. The list is as follows:—Machinery or plant, and parts thereof, bakery machinery and plant, bottling and capping machinery (other than for milk bottling and capping), confectionery and sweet-making machinery and plant, embroidery machinery, hat-making machinery, knitting and hosiery machinery, machinery and plant for making toilet preparations other than soap, machinery for filling and closing containers (other than bottles) for merchandise, packing and wrapping machinery, paper-making machinery and plant, printing and bookbinding machinery, scent-making machinery and plant, sugar-making and refining machinery and plant, textile machinery (including printing and finishing machinery), tobacco, cigar, and cigarette-making machinery and plant, and woodworking machinery.

Copper and Copper Alloys for Gas Appliances

Owing to the very heavy demand for copper and copper alloys at the present time it is of the utmost urgency that the use of these materials for non-essential purposes shall be eliminated, and their use for other purposes be reduced to a minimum by the use of substitute materials wherever possible. In order that more definite guidance may be given in this matter the employment of copper and copper alloys in the production of the articles mentioned below will in future be restricted, except for minor parts for which no substitute can be employed and for the plating or brazing of steel parts where this is necessary. The restriction applies to all goods except those manufactured for export or to Ministry of Supply, War Office, Admiralty, or Air Ministry orders: (*a*) From the date of this communication and until further notice no more licences will be granted, except in very special circumstances, for copper or copper alloys for the manufacture of the following articles:—Ornamental lighting fittings of all types, including table and standard lamps; lighting reflectors, shades, galleries, and shade carriers; reflectors, guards, and ornamental parts of bowl and other types of gas fires and heating appliances; tube connections from points to fires. (*b*) The weight of copper and copper alloys to be used by any manufacturer in the production of the following articles will be determined as follows:—Raw material licences will be granted for the four months commencing June 1st, 1940, to an extent not exceeding 25 per cent. of the tonnage used by the manufacturer during the same period in 1939 for home civil orders only; gas water heaters of all types; wash boilers and washing machines.

Whenever copper or copper alloy products are required for the manufacture of any of the articles mentioned above under headings (*a*) or (*b*) for Service orders, a statement to this effect must be made by manufacturers to their suppliers and be included by the latter in their applications for licences to purchase the necessary raw materials. Particular attention is drawn to the vital necessity at the present time for the exercise of special care in the salvage and repair of all types of apparatus and appliances in order that new replacements may be eliminated wherever possible. If repair cannot be effected the materials scrapped should be suitably graded and disposed of without delay. All firms adhering to the above scheme must quote the symbol "N.F.G." when ordering from their suppliers, who must, in turn, quote the same symbol on the schedules which they submit to the Non-Ferrous Metals Control. The use of this symbol by any firm is to be regarded as an undertaking that the conditions set out above are being fully observed. No application for metal will be considered unless the symbol is quoted.

French Engineering Notes

(From our own Correspondent in Paris)

The Industrial North

THE coal measures that extend from Belgium through the Nord and the Pas de Calais and sink to a great depth under the Channel to reappear in Kent are necessarily the origin of a concentrated industrial activity along the northern departments. At the eastern end, the Lorraine iron ore basin completes the self-sufficiency of this industrial zone with a considerable iron and steel production. From Dunkirk to the Rhine the country is intersected with a network of railways and waterways that connect up all the industrial centres, from the collieries to the iron ore mines, and converge to the consuming and distributing centre of Paris. After the last war, the collieries at Anzin, Courrières, Liévin, Lens, Béthune, and others were raised from the ruins of enemy destruction, equipped with modern installations, and organised by new methods and on scientific lines that doubled and cheapened the coal production and placed the French colliery industry in the very front rank. The same modern reconstruction gave a greatly enhanced value to other devastated industrial areas. General engineering construction became much more important over the area between Lille and Maubeuge, locomotive and wagon-building shops expanded, and the tube mills of Escaut et Meuse at Valenciennes are among the largest and best equipped of their kind. The Nord recovered from the devastation in a manner that gave to it a far greater and better production than before. The department of the Ardennes is mainly a centre of the ironfoundry industry, particularly of malleable iron castings. All through this area the enemy has driven his way to the Channel ports. Lille and other industrial areas are in his hands. Supplies of coal and metallurgical products from those regions are therefore cut off. So long as the enemy remains in them, the isolation of the northern departments from the rest of the country is complete, and it is therefore necessary to take urgent measures to ensure that armament production will not suffer from loss of supplies and of work contributed by those departments to the war effort. The iron and steel production in the Est is, fortunately, protected by a strongly armed resistance from the end of the Maginot line, and the question arises whether the production can be maintained with sufficient supplies of blast-furnace coke. This coke was formerly obtained mainly from the Ruhr and then, when Germany defaulted, supplies came from Belgium, and some of the French collieries were able to produce a certain quantity of acceptable metallurgical coke. The loss of these supplies seriously complicates the problem of carrying on the iron and steel production.

Urgent British Aid Wanted

During the last war the occupation of the industrial north by the enemy had little effect upon the armament output, since its production was much less than it is now, and the deficiency was made good by intensive work in the Paris region, as well as in the Loire and in other parts of the country where machinery was available for turning out ammunition. Armament requirements are now immeasurably greater, and everything is being done to meet them. Machinery and rolled iron and steel and other materials are being removed from proximity to the fighting zone, and the production capacity elsewhere will have to be increased beyond what had already been considered as an extreme limit. Every confidence is placed in Monsieur Dautry, Minister of Armament, who is capable of achieving further success in expanding production with aid from the British Empire. Nothing can be said about the nature of that aid beyond the obvious necessity of supplying coal and metallurgical coke, and if such supplies are forthcoming this country can no doubt intensify armament production up to the limit of its requirements. All the arsenals and State establishments are situated below the latitude of Paris, excepting one aircraft factory, and the partial decentralisation of industry offers opportunities for extending factories and creating new ones with machinery and plant transferred from works at present in the danger zone. These opportunities for increasing output are much more favourable now that the labour strain is relaxed by the influx of Belgian refugees who are expected to provide a considerable number of skilled hands. All that is required is further help from Great Britain in supplying raw materials of which the country is deprived. The resources of Britain and France are pooled for the prosecution of the war, and Great Britain will necessarily provide her ally with what is needed to carry through the most strenuous work she has ever undertaken. All the unions and syndicates of French workers have joined in giving a solemn assurance that they will play their full part. As the home front is so near the firing line they understand the danger, and every man is ordered to stay at his post, whatever happens. The slogan is "Production first, safety afterwards," and the worker is expected to seek safety only when his task is done. The unanimity in submitting to severe discipline has been growing until it is now complete. All work being done is for national defence and for essential needs of the civil population, and the drive for production for export has ceased to be a paramount factor at this critical moment. It has been decided that no public or private works of any kind, not associated with national defence, can be undertaken with borrowed capital, so that, probably for the first time, the country is one vast war factory, which leaves it less liable to be endangered by an isolation of the industrial north than would have been the case if the Minister of Armament had not successfully carried out his plans for a general organisation of war material production. Those plans are certainly deranged by the situation created in the Nord which compromises essential supplies, and it is for this reason that Great Britain will be asked to give every assistance in her power, if it has not already been offered, to enable France to carry on her war production without losing time that may prove dangerous to the common cause. It is a situation that appeals directly to workers in both countries.

British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

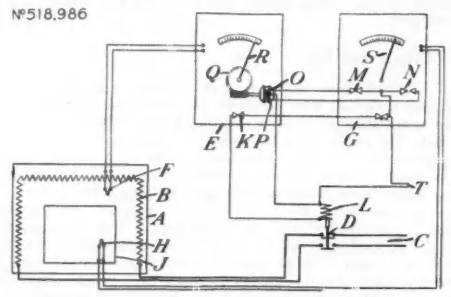
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C.2, 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

FURNACES

518,986. September 14th, 1938.—MEANS FOR CONTROLLING TEMPERATURES IN FURNACES AND SIMILAR APPARATUS, Alfred Glynne Lobley, and Birmingham Electric Furnaces, Ltd., both of Birlec Works, Tyburn Road, Erdington, Birmingham.

In accordance with this invention the furnace chamber A is provided with electric heating elements B connected with the mains supply C having a contactor D in the circuit. The heat input to this chamber is controlled by a pyrometric instrument E operated by a thermocouple F in the chamber. This pyrometric instrument E is adjusted automatically by a second pyrometric instrument G operated by means of a thermocouple H disposed in a work or charge container J within the furnace chamber A. The pyrometer E controlling the supply of heat to the furnace is of the "on" and "off" type having controller contacts K in the circuit of a solenoid L for the contactor D. The pyrometer G which is sensitive to the heat within the work container or muffle J is of the double contact type, employing what is commonly known as the "high and low" contact method, there being a small space between the high and low contacts M N. These contacts are respectively adapted for completing the circuits of the windings O, P of a reversible electric motor adapted for adjusting, through gearing,

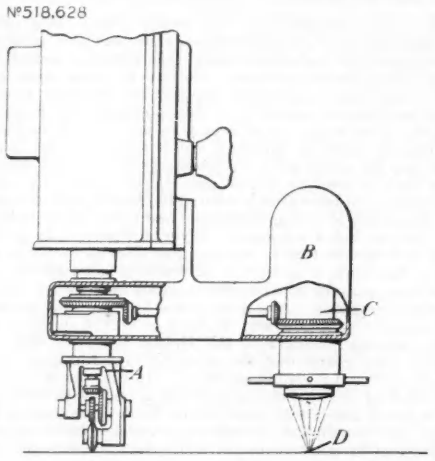


a temperature setting disc Q of the pyrometer E. Each pyrometric instrument is provided with a temperature indicator pointer R S movable over a scale. The contacts M N of the pyrometer G are arranged so as to be both open whilst the temperature of the work chamber is maintained or fluctuates between the predetermined limits imposed in practice. The arrangement is such that if the temperature falls to the temperature of the setting of the contact M, the closing of this contact enables current to pass from the control supply leads T, through the winding O for causing the motor to be rotated, so that the setting of the pyrometer E is raised, thereby raising the control temperature of this instrument. The contact N is opened up to a point just above the predetermined operating temperature for the work container A. If the temperature rises above this temperature the motor is operated in the reverse direction by the connection in the control circuit of the other motor winding P, thereby adjusting the disc Q for lowering the control temperature of the pyrometer E. Thus the difference in temperature between the furnace chamber A and the work container J is adjusted so that heat input of the elements B is correspondingly reduced or increased.—*March 13th*, 1940.

MACHINE TOOLS AND SHOP APPLIANCES

518,628. August 30th, 1938.—IMPROVEMENT IN BLOWPIPE MACHINES FOR CUTTING BY THE USE OF A DRAWING, Messer and Co. G.m.b.H., of Frankfurt/Main, Germany.

In machines for cutting with a blowpipe by the use of a drawing when the lines of the drawing are of intricate shape, it is not easy to guide the tracer wheel with accuracy. In this invention this disadvantage is eliminated by a light point, which is produced by an optical arrangement located in the neighbourhood of the tracer wheel, being used for guiding the blow pipe. Referring to the drawing the control head A is



coupled to a further housing B which contains an optical arrangement C. The latter consists of a light-source and a series of consecutively disposed convex and concave lenses, whereby on the drawing surface a very bright clear visible light point D is produced. By disposing a cross-wire on one of the lenses the light point can be provided with an indicator. The optical device in the housing is freely rotatable about its axis. The rotary movement of the optical device is transmitted with the help of two pairs of bevel-wheels to the control head A, and therewith to the tracer wheel. After the commencement of the cut the light point is so guided that it travels round the outline of the drawing. Through the coupling between the optical device and tracer head the path of the light point corresponds to the path of the tracer wheel and the blow pipe.—*March 4th*, 1940.

METALLURGY

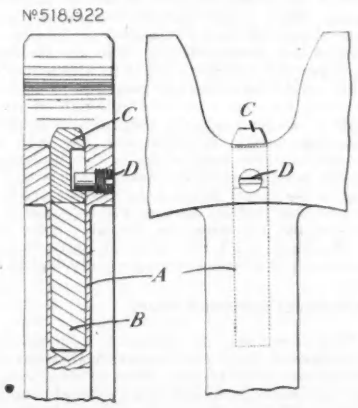
520,282. September 6th, 1938.—IMPROVED STEEL ALLOY, Ruhrstahl Aktiengesellschaft, Auestrasse 4, Witten (Ruhr), Germany.

This invention consists of a steel alloy, for gear wheels and other similarly stressed machine parts, which need not be case-hardened. The steel contains, from 0·1 to 0·5 per cent. of carbon, more than 1·0 to less than 1·5 per cent. of manganese, from 0·2 to 0·5 per cent. of silicon, more than 2·5 to 3·0 per cent. of chromium, and from 0·3 to less than 0·6 per cent. of molybdenum, the remainder being iron with or without the usual impurities. To this steel may be added, if required, tungsten and/or vanadium between 0·1 to 1·0 per cent. of each when both are present to increase the tenacity and the hardness. Comparative tests with gear wheels are claimed to have shown that such a steel tempered in a suitable manner presents as good running properties as a case-hardened steel.—*April 19th*, 1940.

MISCELLANEOUS

518,922. August 10th, 1938.—IMPROVEMENTS IN AND RELATING TO CHAIN DRIVES, J. and E. Hall, Ltd., 10, St. Swithin's Lane, London, E.C., and John Alfred Orpin, 14, Christchurch Road, Dartford, Kent.

It is found that in the case of chain drives of high capacity or considerable load, such as the drives for the step carriages of escalators, noise is frequently produced by the passage of the pivot pins of the chain links into contact with the teeth of sprocket wheels over which they pass. The invention has among its objects to reduce such sounds, to render the working of chain drives more smooth and effective, to reduce wear and in particular to provide improved constructions of chain wheels. In carrying the invention into effect according to one particular construction as illustrated in the accompanying drawings, the tooth recesses, or certain of them, are bored at a middle position in the bottom surface with cylindrical recesses A extending radially into the wheel. Each recess receives resilient



elements B in the form of cylinders of rubber or like material that extend short of the upper end of the recess. At the upper end of the recess is a metal plunger C which when seated upon the resilient element projects above the surrounding surface of the tooth recess. In order to limit the protection of the plunger and to ensure a satisfactory initial compression upon the resilient element a registering pin D is inserted in the flank of the wheel and projects into the recess in which the plunger is mounted in such manner as to engage a lateral recess cut into the side of the plunger. In the operation of the chain drive the pivot pins of the chain links as they pass between adjacent teeth are caused to bear upon the upper ends of the plungers before coming into contact with the bottoms of the tooth recesses. The plungers are thus caused to give way under the pressure of the pivot pins to the extent permitted by the compression of the resilient elements. The pivot pins thus pass gradually into contact with the surfaces of the tooth recesses.—*March 12th*, 1940.

PERSONAL AND BUSINESS ANNOUNCEMENTS

THE BRADLEY PULVERIZER COMPANY informs us that it has temporarily evacuated its London offices and is now at 27, The Albany, Britannia, Worcester.

MR. A. G. FLETCHER, for the last four years secretary of Guy Motors, Ltd., Wolverhampton, has joined Henry Meadows, Ltd., Fallings Park Engine Works, Wolverhampton, as office manager.

MR. E. J. BUCKTON, B.Sc., M. Inst. C.E., M.I. Mech. E., of Messrs. Rendel, Palmer and Tritton, 55, Broadway, Westminster, S.W.1, has been elected Chairman of the Association of Consulting Engineers for the year 1940–41.

SIR ATHOL ANDERSON, K.C.B., Member of Council of the Institution of Civil Engineers, and formerly Civil Engineer-in-Chief of the Admiralty, has, subject to any Government requirement for his services, joined the firm of Messrs. Rendel, Palmer and Tritton, consulting chartered civil engineers, as one of its consultants.

CATALOGUES

DARWINS, Ltd., Sheffield.—Booklet on "Hot-Work" tool steels.

JOHN FOWLER AND CO. (Leeds), Ltd., Leeds.—Brochure, entitled "Achievement," showing typical applications of Fowler-Sanders engines.

ROTHERHAM AND SONS, Ltd., Coventry.—Leaflet describing small pumps of rotary and gear pattern; also a leaflet entitled "Danger Signals," describing oil indicators, industrial clocks, and other instruments.

CONSOLIDATED PNEUMATIC TOOL COMPANY, Ltd., 232, Dawes Road, London, S.W.6.—Leaflets SP 246, Midget Balancer; SP 250, Sludge Pump; SP 251, Sump Pump; SP 252, Pneumatic Drill; SP 253, Power Vane Drill; SP EL 25, Little Giant; No. 200, Combination Electric Hammer and Drill; SP EL 26, Little Giant Electric Drilling Stand.